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vol. 47

Unsoundness in Aluminum Cast

Results of Experiments on Porosity and Unsoundness of No. 12 Alloy of Alumin —Blowholes Are Function of Pouring Temperature, Time Metal is Held in Furnace, and Other Factors

1936 13.1.97

By ROBERT J. ANDERSON

THE study of defects in nonferrous metals and alloys is still in a very backward condition as compared with iron and steel; in aluminum, systematic researches, utilizing the principles of physical metallurgy, have begun only in the last few years. The most common light aluminum alloy [illegible] in the United States for the [illegible]stings is that one [illegible]rcles as No. 12, [illegible] of 92 per cent [illegible] per cent copper.

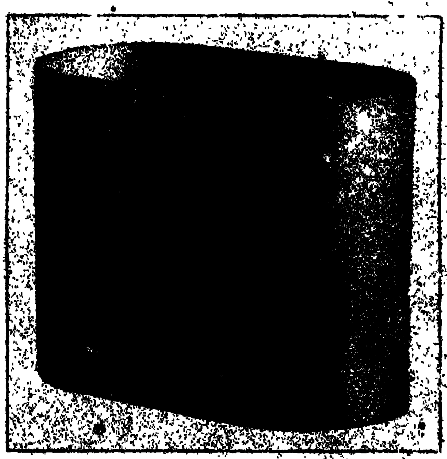
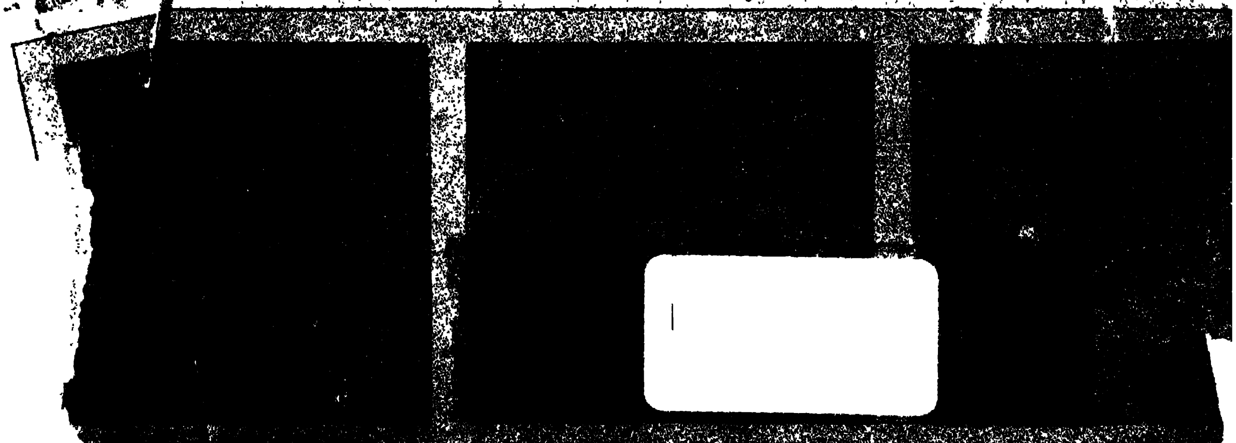


FIG. 1—FORM OF THIN SHELLS POURED IN THE CASTING EXPERIMENTS

This alloy, or others of [illegible] composition, is employed [illegible] variety of castings, [illegible] founders are doubtless [illegible] with it than any other [illegible] founders have long rec[illegible] pouring temperature is [illegible] factor in [illegible] the castings, [illegible] stress has [illegible] ness and the factors [illegible] engineers and founders [illegible] opinion that [illegible] specific gravity, is [illegible] of aluminum alloy [illegible] a matter of fact, howe[illegible] [illegible] are light, [illegible] castings. There are, [illegible] [illegible] the kin

[illegible] by the permission of the [illegible] Bureau of Mines. It is [illegible] a forthcoming publication of [illegible] Robert J. Anderson is metal[illegible] Mines experiment station, Pitts[illegible] specimens illustrated, Figs. 3 to 23, were etched with NaOH.



[illegible] HOLE AND GENERAL UNSOUNDNESS IN 92-8 AL-CU ALLOY UNETCHED FROM CRANK CASE 5 DIAMETERS FIG. [illegible] AL-CU ALLOY FROM CRANK CASE SHOWING [illegible] IN OPEN [illegible] 7 DIAMETERS FIG. [illegible] AND BLOW-HOLES IN 92-8 AL-CU [illegible] AT [illegible] DEGREES CENT. 7 DIAMETERS

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BL-

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..e molding practice, and
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..tings within the limitations
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will appear later in the
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oundness in sand cast
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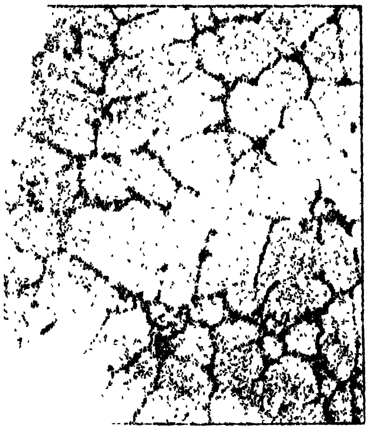
Porosity in castings that



POURED AT 656 DEGREES,
AVERAGE STRUCTURE,
ION 75 DIAMETERS

oline test or
sure constitutes
manufacturers of
aft castings.
aluminum-alloy cast-
le have been more or
this statement can read-
died by examining polished
tions of samples taken at
m. Typical examples are shown
gs. 2 and 3, where the former
macrograph at five diameters of
section cut from a crankcase and

the latter a macrograph at seven diameters of a section cut from a portion of another crankcase showing seepage in the open gasoline test. These are not exaggerated examples at all, and more or less similar results can be observed by examining almost any casting. The conclusion should not be drawn that all aluminum-alloy castings are totally unsound throughout all parts, the term unsoundness is only relative at best. In a complicated casting, some portions will be likely to be more unsound than others, but at the present writing unsoundness would appear to be presupposed in connection with aluminum-alloy castings. Some tests have been made in connection with the present work for the purpose of studying the effect of pouring temperature on the soundness of the 92·8 aluminum-copper alloy and also the effect of time of melting on the same property. In the tests about to be described, confirmatory evidence of already known facts has been obtained and some new data have been made available.

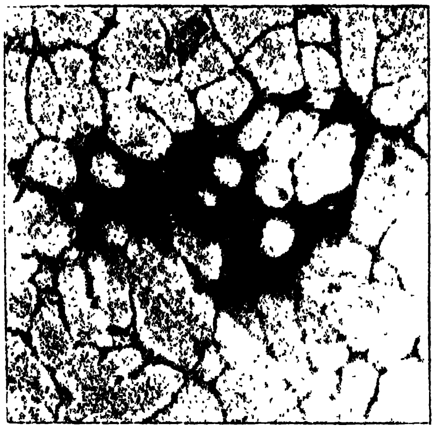


FIG. 7 SAME AS FIG. 6 BUT SHOWING UN-SOUNDNESS. 75 DIAMETERS

The present article will not deal at all, except to mention it, with the influence of furnace atmosphere on the properties of aluminum alloys, but that is a question which merits serious consideration by metallurgists and one that seemingly has been given entirely too little attention. The question of the solubility of gases in aluminum and the formation of loose compounds at elevated temperatures is one that apparently has considerable importance, and studies in this direction should prove fruitful. However, only the briefest mention of these matters can be made now. Various elaborate methods, in the case of steel, have been perfected for the prevention of blowholes, and it would not appear to be straining analogy to say that a consideration of the many methods in vogue for preventing unsoundness in steel might possibly prove of value in studying the same defect in aluminum-alloy castings.

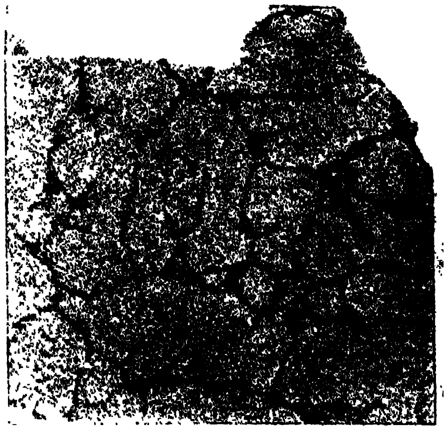


FIG. 8—HEAT B, POURED AT 850 DEGREES, FROM THE BAR, AVERAGE STRUCTURE, SOUND PORTION; 75 DIAMETERS

In the preliminary tests made in connection with the present work, small heats of about 25 pounds each
of the 92·8 alum
were made up
charged as fol
amount of 50-50
alloy was first me
bago-clay crucible,
furnace; when the
melted, enough virgin
got, in the form of three-p
notch bars, together with
per cent of No. 12 ga 10
and Asers

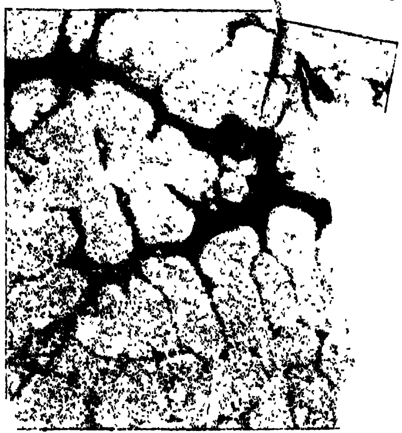


FIG. 9 SAME AS FIG. 8, BUT SH
GRANULAR UNSOUNDNESS; 75

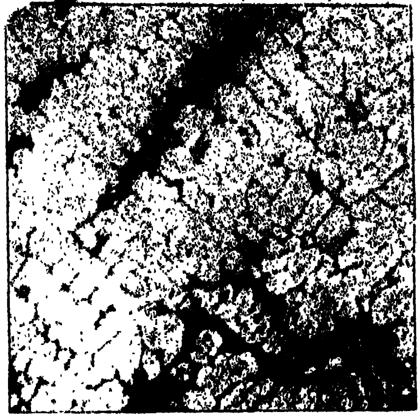
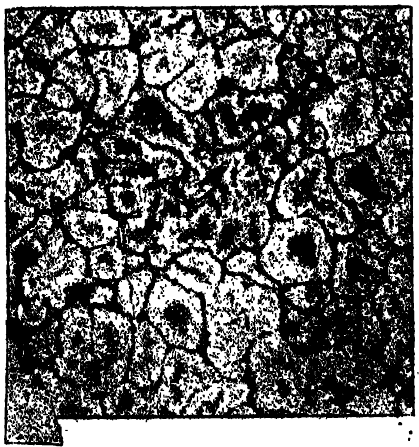


FIG 10 HEAT *B*, POURED AT 850 DEGREES CENT. FROM THE BAR, AVERAGE STRUCNESS; 75 DIAMETERS

were added to make up the heat. Six sets of castings were poured, and the essential information is summarized in Table [illegible]. The castings were simply thin shells as shown in Fig. 1, the dimensions being roughly 7½ by 6 by 4⅛ inches and ⅛-inch thick. The cut-out portion is the place from which a microsection was taken for microscopy. Two kinds of castings were poured from the first six heats, (1) the thin shells, and (2) bars, 0.75 inch square by 12 inches long. The shells are hereafter referred to as castings and the bars as bars. Castings of different thicknesses were thus poured for the purpose of ascertaining whether any exaggeration of defects might be traced to size of section under otherwise identical conditions. The castings were poured in ordinary sand molds properly rammed and vented; each thin shell was poured in a single mold and its companion bar in another separate mold. In the first si[illegible] the influence of pouring te[illegible]e and length of time in m[illegible] soundness was observed. Duplicate runs, in which the data were practically the same as shown in Table I, were made for checking purposes. The average chemical composition of the first set of six castings and bars was, copper 7.62 per cent, iron 0.39 per cent, silicon 0.25 per cent, and aluminum 91.73 per cent by difference.



1—HEAT *C*, POURED AT 630 DEGREES
. FROM THE BAR, AVERAGE STRUC-
RE, SOUND PORTION; 75 DIAMETERS

Additional Tests

Additional tests on the effect of pouring temperature alone on unsoundness were performed by making up 60-pound heats of the 92:8 aluminum-copper alloy, in the manner described, and pouring 1.50-inch square by 12 inches long bars, at 50 degrees Cent. intervals as shown in Table II. Duplicate runs were made for the purpose of checking.

In the tests summarized in Table II, a charge of 60 pounds was heated rapidly to 975-1000 degrees Cent.; the crucible was then removed from the furnace, and bars were poured at 50 degrees Cent. intervals from the same pot by allowing the melt to cool between pours. The range of pouring temperature, as indicated in Table II, was from 950 to 650 degrees Cent. The average chemical composition of a composite sample of the 1.50-inch square bars was copper 7.55 per cent, iron 0.36 per cent, silicon 0.29 per cent, and aluminum 91.80 per cent by difference. In connection with these tests, some interesting information on the contraction of the No. 12 alloy was furnished by examination of the frozen pouring gates, and this will be dealt with in a later paragraph. The resultant castings and bars, referred to as *A* to *M* inclusive were examined for surface appearance and microscopically for general characteristics and unsoundness. Polished microsections of both castings and bars were examined macroscopically and machined surfaces were examined for blowholes. All temperatures in the above experiments were taken with a base-metal thermocouple of the pyro type which was calibrated to insure its accuracy.

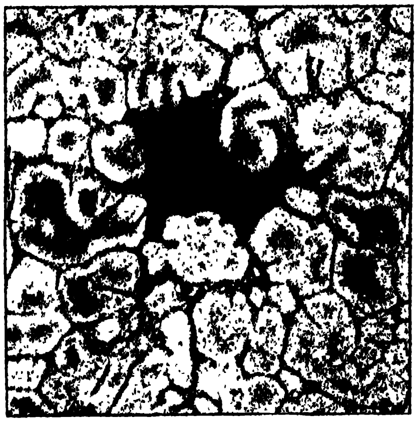


FIG 12—SAME AS FIG 11, BUT SHOWING UNSOUNDNESS 75 DIAMETERS

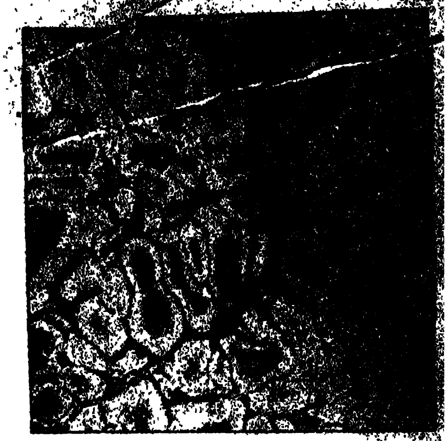


FIG. 13—HEAT *D*, POURED AT 640 DEGREES CENT., FROM THE BAR, UNSOUNDNESS; 75 DIAMETERS

The castings and bars poured in heats *A* to *M* inclusive were examined macroscopically and microscopically for blowholes, porosity, and general soundness. In examining castings for relative unsoundness, this defect can best be judged by simply inspecting polished or machined surfaces. Microscopic examination is not so useful. In the present experiments, bars cast from the various heats were machined smoothly by milling, and the surfaces were inspected for holes. Microsections from the bars and castings were also prepared and studied. It has been previously stated that soundness in aluminum-alloy castings is a relative term at best and that all castings are more or less porous. Hence, the term "soundness" should not be regarded as absolute but as roughly descriptive. Figures 4 and 5 are indicative of what a macrograph can show as regards soundness. The former shows the surface appearance of a microsection cut from a 0.75-inch square bar cast

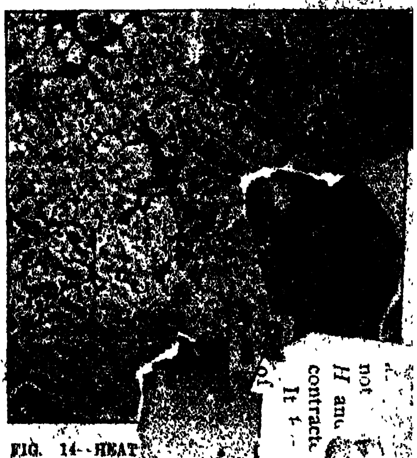


FIG. 14—HEAT
CENT., FR
STRUC

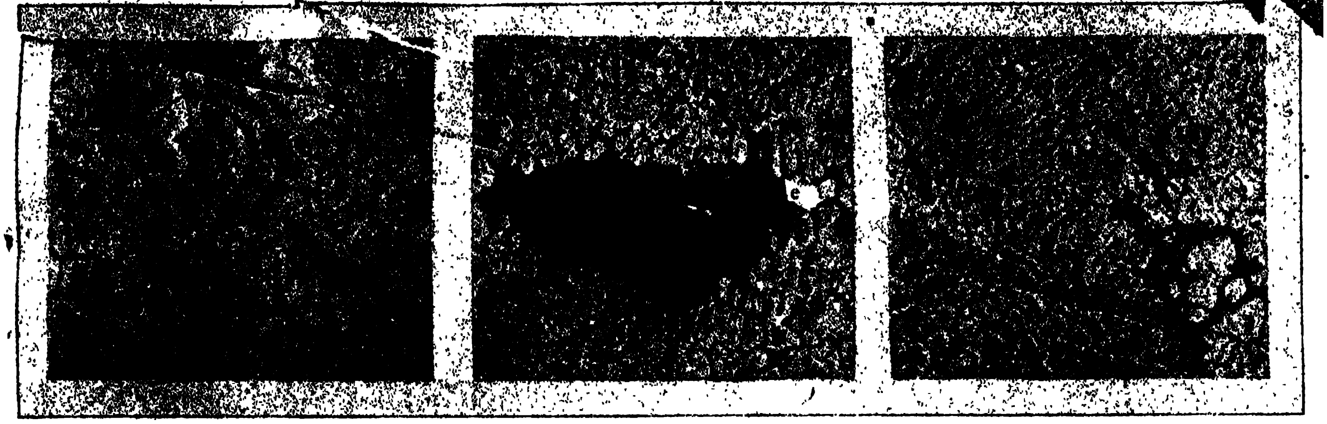


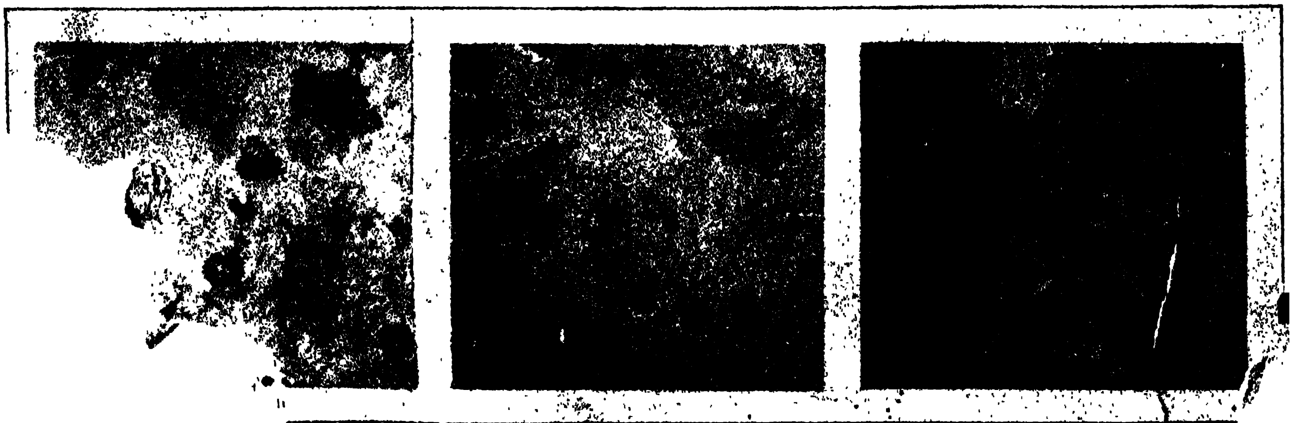
FIG. 15—HEAT *E*, POURED AT 950 DEGREES CENT., FROM THE BAR, AVERAGE STRUCTURE, SOUND PORTION, 75 DIAMETERS FIG. 16—HEAT *E*, POURED AT 950 DEGREES FROM THE CASTING, UNSOUNDNESS; 75 DIAMETERS FIG. 17—HEAT *F*, POURED AT 700 DEGREES CENT., FROM THE CASTING, AVERAGE STRUCTURE, SOUND PORTION, 75 DIAMETERS

from heat *D*; the latter is a similar macrograph from heat *E*. Heat *D* was poured at 640 degrees Cent., and heat *E* at 950 degrees Cent. Machined surfaces also show relative unsoundness fairly satisfactorily. Macrographs on samples from heats *G* to *M*, inclusive, prove extremely instructive and a few of these are reproduced in Figs. 19 to 22 and Fig. 24, inclusive. In general, the number of blowholes per unit area in a casting increases with increasing pouring temperature. Fig. 24, from heat *M* poured at 650 degrees Cent., shows no holes at all, but many holes may be seen in Figs. 19, 20 and 21.

A detailed elucidation of the micrographs in Figs. 6 to 18, inclusive, may prove interesting. It may be noticed in comparing the microstructures of the 0.75-inch bars and the ⅛-inch thick castings, that in the former the grain size is much larger than in the latter. This is, of course, to be expected since the thin casting is chilled much more rapidly by the sand than a thick one; a thick casting may even exhaust the thermal capacity of a sand mold, before it freezes, provided conditions are conducive to that end. The micrographs give evidence of at least three kinds of unsoundness: (1) That which is plainly intergranular and may be due to an actual forcing apart of the grains by gas attempting to find an exit to freedom, or to intergranular occluded foreign matter which is a source of weakness at best and in effect results in unsoundness; (2) that due to actual liberation of gas which is entrapped at the moment of final freezing; and (3) that which is the result of a balled-up oxide occluded in quite large gobs, in an indiscriminate fashion in the frozen alloy. Intergranular occluded foreign matter, whether oxide or what not, is well shown by Figs. 9 and 13, while unsoundness due to the third cause mentioned is illustrated by Fig. 16 Actual blowholes or holes from which occluded foreign matter has dropped on polishing are shown in the low power illustrations in Figs. 19, 20 and 21.

FIG 18—SAME AS FIG. 17, BUT SHOWING UNSOUNDNESS—100 DIAMETERS

The proposal has been made by Wheeler P. Davey and others, and actually carried out in some instances, that X-ray photographs of castings would prove useful in determining the soundness of castings. In fact, Tonamy (Jour. Inst. Metals, vol. 14, 1915, pp. 200-203) proposed to decide by radiographs whether or not certain copper castings were worth machining. Now some machine shop scrap is the result of findi[illegible]ith the porosity and blowholes af[illegible] a few cuts with a milling [illegible], for example, in machining aluminum-alloy motor castings. In connection



0 DEGREES; 7 DIAMETERS FIG 20—HEAT *H*, POURED AT 900 DEGREES; 7 DIAMETERS FIG. 21—HEAT *J*, AT 800 DEGREES; 7 DIAMETERS

FIG. 22—HEAT L, POURED AT 7[illegible] DEGREES; 7 DIAMETERS

with the tests described, it was the thought that possibly an X-ray examination would be of assistance in locating the presence of internal blowholes as well as general porosity and sponginess, without cutting the suspected samples and polishing as in metallography. Some radiographs were made of flat plates, 0.25-inch thick, and of bars, 1-inch square. Samples of each were deliberately made porous by pouring at a high temperature in a damp mold, and radiographs on these were compared with radiographs on fairly sound samples correctly poured.

An X-ray tube with a tungsten target was used for radiography. A few radiographs were made on very porous samples obtained from various aluminum foundries. The results of the X-ray work would indicate that this apparatus is of no particular use (for practical purposes) in detecting internal blowholes. In complicated castings, suitable radiographs would entail considerable difficulty in preparation and probably a large number of radiographs would have to be taken on any given casting to decide whether it was worth machining or not. From the practical standpoint, it is difficult to see how the X-ray examination of aluminum-alloy castings has any application at the present time. Actually, it will simplify matters greatly from the machine-shop standpoint to make the castings sound in the first place in the foundry. Also, it may not be altogether out of place to suggest here that it will be foundry economy to produce finished castings on the foundry floor rather than to try to patch them by

Table I

Influence of Pouring Temperature and Length of Time of Melting

Heat	Treatment	Pouring temperature Degrees Cent.	Remarks applying to appearance of castings.
A	Heated the charge to 630 degrees Cent. and poured at once.	630	White, good, smooth appearance.
B	Heated the charge rapidly to 860 degrees Cent. and poured at once.	850	Tinted with oxidation stains, rough appearance; many surface holes.
C	Heated the charge rapidly to 880 degrees Cent., removed from furnace and cooled to 630 degrees Cent.	630	White, fair appearance; cold [illegible]
D	Heated the charge to 650 degrees Cent., and held in the furnace for one hour at 650-720 degrees Cent.	640	White, fair appearance; cold [illegible] so marked as in C.
E	Heated the charge rapidly to 900 degrees Cent. and held in the furnace for one hour at 900-950 degrees Cent.	950	Oxidation stains; bad looking castings; rough; many surface holes.
F	Heated the charge rapidly to 900 degrees Cent., held in the furnace for one hour at 900-950 degrees Cent.; removed from furnace and cooled to 700 degrees Cent.	700	White, fairly good surface appearance.

(a) Duplicate runs of 25-pound charges were heated in a gas-fired furnace

(b) Average chemical composition was, copper 7.62 per cent; iron, 0.39 per cent; silicon, 0.26 per cent; and aluminum, by difference, 91.73 per cent.

Table II

Metal from the Same Charge Poured at Different Temperatures

Heat	Pouring temperature Degrees Cent.	Remarks applying to appearance of castings
G	950	Soundness, surface appearance and color varies with the pouring temperature.
H	900	
I	850	
J	800	
K	750	
L	700	
M	650	

(a) Duplicate runs of 60-pound charges were heated in a gas-fired furnace to 975-1000 degrees Cent., the crucible was then removed from the furnaces and bars were poured at 50 degrees Cent. intervals.

(b) Average chemical composition was, copper 7.35 per cent; iron, 0.36 per cent; silicon, 0.29 per cent; and aluminum, by difference, 91.80 per cent

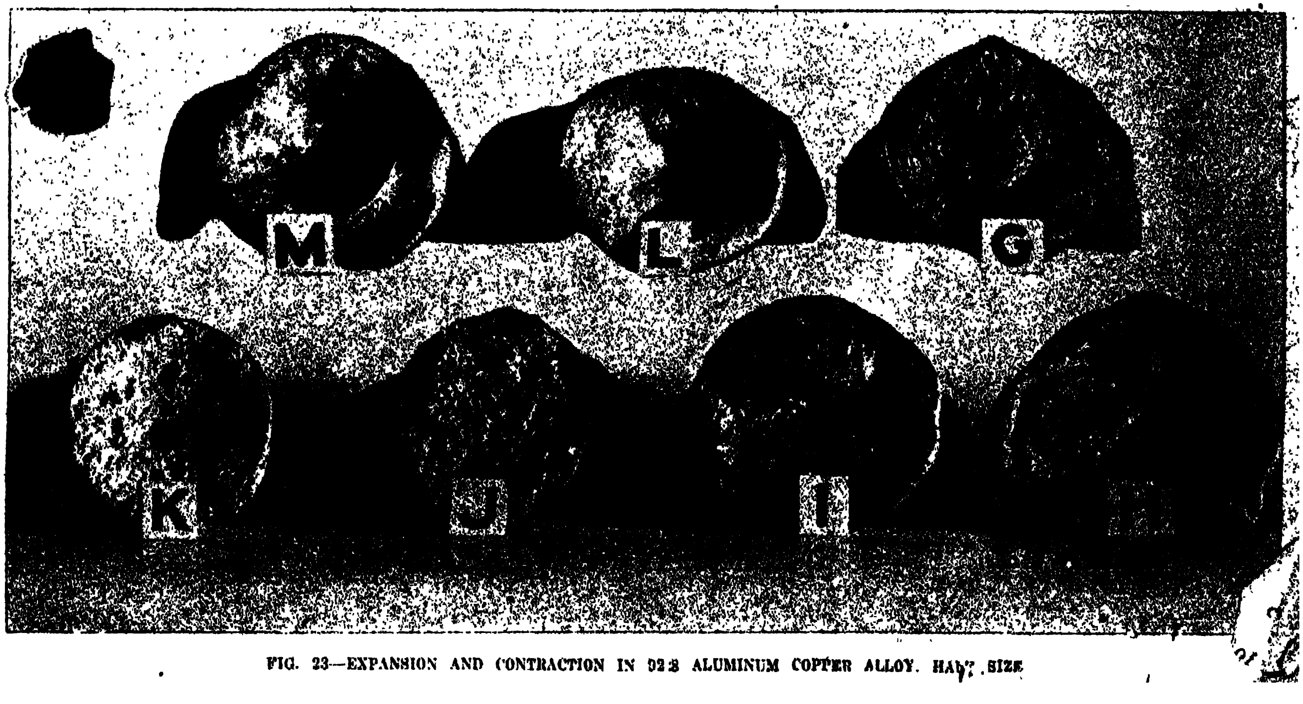


FIG. 23—EXPANSION AND CONTRACTION IN 92-8 ALUMINUM COPPER ALLOY. HALF SIZE

later welding and otherwise doping.

Turner suggested a supposed expansion of aluminum some years ago, but Chamberlain (Journ. Inst. Metals, vol. 10, 1913, pp. 193-234) in referring to Turner's work stated that the apparent expansion could be accounted for by dissolved gases in the metal. A striking example of the effect of various factors on the contraction of the 92:8 aluminum-copper alloy was shown in the present work in the heads of the pouring gates of the series of bars cast at 50 degrees Cent. intervals, namely, heats *G* to *M*, inclusive. The amount of contraction is a function of the pouring temperature, so far as the limitations of the experiments can show, but whether it is also, and at the same time, connected with dissolved gases is not certain. It is a fact, however, that a casting poured at 950 degrees Cent. contains more dissolved gases at the moment of pouring than another similar one poured at 650 degrees Cent. The greater solubility of gases in liquid metals with increasing temperatures is a departure from the general laws governing solutions of gases in aqueous liquids.

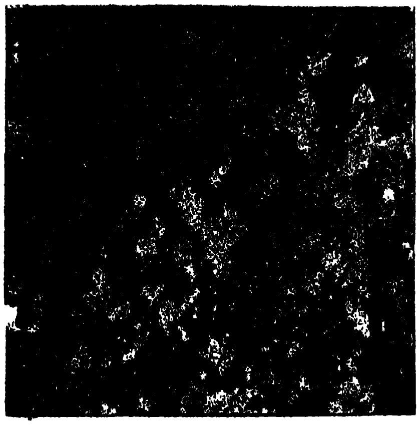


FIG 24—HEAT *M*, POURED AT 650 DEGREES 7 DIAMETERS

The effect of temperature, or dissolved gases, or both, on the contraction of the 92:8 aluminum-copper alloy is shown strikingly by Fig. 23. Here gate *G* was poured at 950 degrees Cent. and gate *M* at 650 degrees Cent., and the others at 50 degrees Cent. intervals as indicated in Table II. Gate *G* actually expanded while the shrinkage in gate *M* is marked and apparently normal. Gradations in degrees of expansion and contraction are shown in the other gates depending on the pouring temperature. Gate *J*, poured at 800 degrees Cent., apparently did not contract or expand much; gates *G*, *H* and *I* expanded; gates *K*, *L* and *M* contracted.

It has been hinted that the solubility of [illegible] in aluminum is a cogent factor in governing blowholes, porosity and contraction. This is an important study in connection with the production of aluminum-alloy castings, but only the briefest mention can be made regarding this now. Aluminum metallurgists, however, will doubtless find that a consideration of this question will furnish interpretable data that can be applied to the solution of foundry difficulties in connection with melting practice.

The conclusions drawn from an examination of the rough castings, of machined surfaces of the bars, and of polished microssections cut from both castings and bars are these:

A.—The number of blowholes present in a function of the pouring temperature; the higher the pouring temperature, the greater the number of blowholes and the more unsound is the casting.

B.—Unsoundness varies with the temperature to which the charge was heated; the higher the temperature in the furnace, the more unsound the resultant castings are, irrespective of the pouring temperature.

C.—Unsoundness is a function of the length of time of melting; the longer any melt is held in the furnace, the more unsound are the castings, irrespective of the temperature of heating and the pouring temperature.

It can be readily seen that the factors affecting the soundness of castings can influence one another either favorably or adversely. Thus, pouring an overheated melt at a lower temperature by allowing the charge to cool prior to pouring will aid in minimizing the deleterious effects of overheating. Castings poured at low temperatures are more sound than those poured at high temperatures, but heats held in the furnace for a long time at either high or low temperatures are more unsound than those held for a short time. The most aggravated cases of unsoundness will result from pouring a melt at a high temperature which has previously been grossly overheated and for a long time. There is nothing to lead to the belief that there is a minimum temperature below which it is not safe to go for fear of unsound castings resulting from too low pouring temperature. The results of the experimental heats and also past foundry experience, together with the general information available, would lead to the conclusions that with the methods of melting now in vogue, the heats should be kept at a low temperature in the furnace; melting should be as rapid as possible, i. e., the charge should be poured as soon as it is melted; and the pouring temperature should be so low as is consistent with the metal filling the mold. This means nothing other than close supervision of melting and pouring, together with a study of the appropriate correlation between the molding floor [illegible] the furnace room. It will be best to have the molding floor waiting for metal rather than have the furnace room waiting for molds. Close pyrometric control is also presupposed in actual foundry production.

Malleable Iron Burned by Too Much Air

By H. E. Diller

Question: We have been getting good malleable iron with a tensile strength of approximately 50,000 pounds per square inch, but at present the iron smokes as it comes from the furnace and the castings are honeycombed. We melt a charge in 3 hours and 10 minutes. We charge at 1.30 per cent silicon and get iron with 0.47 per cent silicon and 1.80 per cent carbon. The brown smoke comes from the metal before it is hot enough to pour so I do not see how it can be burnt.

We are using fuel oil. How much should be required to melt a ton of metal?

Answer: There is no doubt but that you are burning your iron by using an excess of air. The amount of air should be cut down and you should not try to melt your iron so fast. Oxidation of the metal also burns out silicon and carbon. The silicon should not be reduced more than 0.25 per cent. The more carbon you burn out the higher you must heat the iron in order to get it to run properly. This in turn tends to burn out more carbon.

Iron will burn with a large excess of air even before it is hot enough to pour. An extreme illustration of this is the burning of steel with the oxy-acetylene flame. In this process the edge of the steel is heated with the flame, then an excess of o[illegible] is turned on and this cuts the [illegible] by burning it.

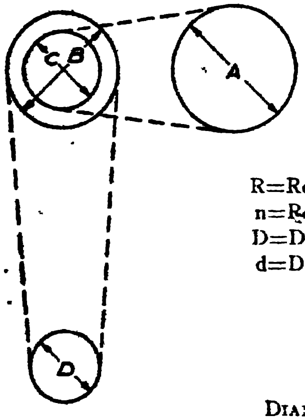
You should be able to melt [illegible] using 35 gallons of oil to the ton.

Artificial Molding Sand

W. J. Nelson, president and general manager of the West Albany Molding Sand Co., West Albany, N. Y., announces that after 10 years spent in trying out different processes he has developed an artificial sand which can be made on a commercial basis. The advantages claimed for this sand are that it is bonded so that it will withstand the flow of the metal without cutting, but contains no excess bonding material; it is uniform and of the proper size to allow the gases to escape without being too course, and it is free from vegetation which would develop gas when burned by the hot metal, thus eliminating one trouble.

DATA ON BELTS AN[illegible]EYS

By W. L. Try[illegible]



REVOLUTIONS PER MINUTE OF DRIVEN PULLEYS

The number of revolutions per minute of a driven pulley is equal to the product of the revolutions per minute of the driving pulley and the diameter of the driving pulley divided by the diameter of the driven pulley. Or where

R=Revolutions per minute of the driven pulley.
n=Revolutions per minute of the driving pulley.
D=Diameter of the driven pulley.
d=Diameter of the driving pulley.

$$R=\frac{d\ n}{D}$$

DIAMETERS OF DRIVEN PULLEYS

The diameter of a driven pulley is equal to the product of the revolutions per minutes of the driving pulley and the diameter of driving pulley divided by the revolutions per minute of driven pulley.

$$D=\frac{d\ n}{R}$$

DIAMETERS OF DRIVING PULLEYS

The diameter of a driving pulley is equal to the product of the diameter of driven pulley and revolutions per minute of driven pulley divided by revolutions per minute of driving pulley.

$$d=\frac{D\ R}{n}$$

REVOLUTIONS PER MINUTE OF DRIVING PULLEY

The number of revolutions per minute of a driving pulley is equal to the product of the diameter of driven pulley and the revolutions per minute of driven pulley divided by the diameter of driving pulley.

$$n=\frac{D\ R}{d}$$

(Continued on Data Sheet No. 300)

THE FOUNDRY DATA SHEET, NO. 299, SEPT. 1, 1919

DATA ON BELTS AND PULLEYS

By W. L. Tryon

(Continued from Data Sheet No. 299)

REVOLUTIONS PER MINUTE OF DRIVEN PULLEY IN COMPOUND DRIVE

The number of revolutions per minute of the second driven pulley is equal to the product of the revolutions of the first driving pulley and the quotient obtained by dividing the product of diameters of driving pulleys by the product of diameters of driven pulleys. Or where,

A and B=Diameters of the driving pulleys.
C and D=Diameters of the driven pulleys.
N=Revolutions per minute of second driven pulley.
n=Revolutions per minute of first driving pulley.

$$N=\frac{n\ A\ B}{C\ D}$$

PULLEY DIAMETERS IN COMPOUND DRIVE

Place the revolutions per minute of the driving pulley as the numerator of a fraction and the revolutions per minute of the driven pulley as the denominator, and reduce this fraction to its lowest terms. Then resolve both numerator and denominator into two factors and multiply each pair of factors (that is one in the denominator and one in the numerator) by a number which will give pulleys of large enough diameter.

Example: The number of revolutions per minute of A=320 per minute.
The number of revolutions per minute of D=900 per minute.

$$\text{Fraction}=\frac{320}{900}=\frac{16}{45}\ \text{resolve into factors}\ \frac{8\times 2}{9\times 5}$$

$$\text{Multiplying pairs by same numbers}=\frac{(8\times 1)\times(2\times 4)}{(9\times 1)\times(5\times 4)}$$

$$\frac{8\times 8}{}$$

$$\text{or}\ \frac{8\times 8}{9\times 20}$$

∴ 8 and 8 are diameters of driven pulleys C and D and 9 and 20 are diameters of driving pulleys.

(Continued on Data Sheet No. 301)

THE FOUNDRY DATA SHEET NO. 300, SEPT. 1, 1919

Note—This sheet may cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

will be made for all contributions on foundry and pattern shop practice suitable for pu

Electric Furnace Improves Gray Iron

Duplex Process of Melting in a Cupola and Finishing in an Electric Furnace is Advocated for Certain Classes of Gray-Iron Castings Where Quality is the First Requisite

By GEORGE K. ELLIOTT

THE central facts and fancies embodied in this paper are either taken from or inspired by divers experiences with a basic-bottom Heroult electric furnace at the plant of the Lunkenheimer Co., Cincinnati. Inasmuch as these experiences extended over a period of nearly two years, and as the electric furnace is presented in a service different from usual, the author feels that his subject, at least, is justified by both a reasonably ample observation and a certain novelty of matter.

The growth of the electric furnace in the field of steel castings has been widespread and irresistible; but, so far, the homely gray-iron casting has been beneath its exalted attention. Or, is it that the cupola furnace, venerable and efficient to a remarkable degree, has been a citadel too mighty to be overwhelmed by the invasion of the electric furnace, as were the established furnaces of the steel foundries? However it may be the author believes the electric furnace has a very fair chance to break through into the domain of iron castings, at points in the line where the hammering of modern engineering for supergrades of castings is rapidly effecting a perceptible breach.

[illegible]es Requiring Special Iron

[illegible]rd to gray-iron castings, it [illegible] denied that today there are cl[illegible]f castings for which the insistent demand is for physical properties of a higher order than are commonly characteristic of such iron. Possibly every branch of engineering has some castings that should be, and sooner or later may have to be, made of better gray iron than is now used. One case, and the direct cause of the experiences here related, is that of steam valves for high-pressure and superheated steam. Both pressures and temperatures of the steam used in power plants have passed through a period of exceptional growth, placing upon the apparatus for handling steam severer demands than ever before. Similar is the case of cylinders for locomotives using superheated steam. Also there is the case of cylinders for internal combustion engines.

The two prime qualities most generally wanted in high-grade gray cast iron are strength and solidity, properties which usually are concurrent. The best strength gray iron shows is when under compression, and its worst, under impact and vibration; between come transverse strains and tension. If the cases are studied in which unusual strength of iron is required, it is discovered that almost always the castings are to be used where they will be subjected to either impact, vibration or tension; or, in fact, where cast iron is at its greatest disadvantage.

Solidity Defined

Under the head of solidity may be included a number of related items such as density, closeness of grain and freedom from subcutaneous imperfections such as slag inclusions, graphite segregations, blow-holes, shrink-holes, and the like. Solidity is an excellent goal for the aspiring foundryman; but, in going after high specific gravity he has to beware that he is not lured out from the realm of true gray iron into the dangerous domain of mottled and white irons where brittleness lurks to impair the impact strength of castings, and hardness to ruin their machinability.

Strong irons without exception require high pouring temperatures because they have high melting points and minimum fluidity. The irons most easily melted and, consequently, the most fluid ones, have high percentages of phosphorus in their make-up. Medium and high phosphorus irons comprise by far the greatest part of the melt of the gray-iron foundries of the country. They are the popular casting irons; and it is no extravagance to say that phosphorus has done as much or even more than any other element to popularize gray iron for castings. Still, phosphorus has the grave fault of unfavorably affecting the strength of iron, a thing it accomplishes by forming in the iron mass a network of structurally free phosphide which is quite brittle. Although easily fluid, high phosphorus irons are brittle and generally lacking in strength; conversely, tenacious, strong irons are necessarily low in percentage of phosphorus contained. The well known fact that strength and fluidity do not go hand in hand brings to light the greatest defect of the cupola furnace—its thermal limitations. It is the foundryman casting strong iron who knows best these limitations. The complete melting operation as it takes place in any furnace is divided into three obvious stages—preheating, melting proper, and superheating. For the first two, the cupola is the furnace preeminent; but for superheating it is not the same paragon of excellence.

All ordinary grades of gray iron—those with medium and high percentages of phosphorus—cannot be melted more easily or more economically than in the cupola. For melting efficiency this furnace takes precedence over its two closest rivals—the reverberatory or air-furnace, and the regenerative open-hearth furnace. For simplicity of construction, low cost of installation and upkeep, ease of operation, and economy of melting, it has no real competitor; and there is no probability that, for the great run of ordinary gray-iron castings, it ever will be displaced, although its improvement is conceivable. From the standpoint of process alone, no fault can be found with the cupola; but, from the high ground of product, it shows defects. The two worst of these are its weakness as a superheater for molten iron, and its incapacity as a refiner. The cupola is not a refining furnace and sometimes its hottest possible iron is not hot enough for the best casting results to be secured.

Hotter Iron is Obtained

The thermal limitations of the cupola are inflexible and often tenacity has to pay the price of fluidity. If the demand for supertenacious and solid iron also becomes inflexible, there arises a dilemma which is capable of but one solution, and that is, the attainment of hotter iron. This can be done either through the elimination of the cupola with the substitution of a better superheating furnace, or through retaining the cupola and supplementing it with a more capable superheating furnace. In view of the unequaled economy of the cupola for preheating and melting, a method of supplementing is preferable. This means the introduction of a duplex process into the gray-iron foundry

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A paper presented at a recent meeting of the American Electrochemical society, held in New York City. The author, George K. Elliott, is chief chemist of the Lunkenheimer Co., Cincinnati.

Duplex processes are well established and of excellent repute among makers of steel; but, for the production of gray iron, they have been entirely neglected, leaving virgin a promising field for development in the making of molten iron for the highest grade of gray-iron castings. For a supplemental furnace to the cupola, there are several eligible types. Among these are the reverberatory furnace, the regenerative furnace and the electric furnace. The air furnace, the author hardly considers sufficiently suited to the work. The regenerative furnace promises better, especially where a large tonnage is to be handled at one time. Still, in the end, the author believes the arc electric furnace presents the most alluring possibilities for really extraordinary castings.

The foundry with which the author has been connected has made a specialty of high-pressure steam-valve castings with extreme solidity exacted, and the tenor of his experiences there has been such as to prejudice him strongly in favor of the basic-bottom arc electric furnace as the best auxiliary for the cupola in a duplex process for the production of truly high-class gray-iron for castings having rigid requirements.

Basic Lining Refines

At this point we anticipate the question as to why the basic furnace is preferred. If superheating only is desired, it is entirely probable that the acid furnace should be given the preference; but if an important amount of refining is advantageous, the basic furnace should be used. It is true that the acid arc electric furnace exerts a considerable refining influence by virtue of the reducing condition so readily maintained in it. On the other hand, the refining tendency of the basic furnace is so much more pronounced and so readily responsive, that the iron charge is perforce refined at the same time it is being superheated. By the time the charge has reached the pouring temperature it also has reached a highly refined condition; and, among other results, the sulphur has been reduced very materially, provided, of course, the proper basic and reducing slag has been maintained.

Sulphur in cast iron has so long been considered a necessary evil that its presence not only is commonly condoned, but occasionally is credited with certain benefits. No doubt there are a few of these last, for instance, where it aids in producing chill; but, in general, there is good reason to believe that iron is much better for its absence. That it induces unsoundness when in excess is general knowledge in foundries specializing in castings of a solidity that is a matter of severe test; high pressure valves are an example. Sluggishness of metal is a closely allied evil that travels in the train of sulphur and works unfavorably to solid castings. A medium or high sulphur content is inevitable in the product of the cupola furnace, while in the basic electric furnace its practical elimination is almost a matter of course. The basic electric furnace removes most of the sulphur while the metal is being superheated. This reaction makes possible for the electric furnace certain obvious compensating economies in the choice of raw materials used in the cupola phase of the process. Iron coming from the cupola with 0.100 per cent sulphur, after undergoing about 25 minutes heating in the basic electric furnace under the proper reducing slag generally will contain about 0.030 per cent. One heat the author has in mind was reduced from 0.099 per cent sulphur to 0.022, and another from 0.088 to 0.018 per cent. This possibility of so low sulphur in gray-iron castings may possibly open up a new field for metallurgical investigation.

Carbon regulation, total as well as combined and graphitic, is possible to a most useful extent in the electric furnace. By placing steel scrap in the furnace before adding the molten iron from the cupola, total carbon can with accuracy be reduced to any desired extent. By this simple, unfailing means, gray iron of the socalled semisteel quality may be obtained with great uniformity of composition, structure and strength. Uniformness among different heats, homogeneity in the individual heat, close carbon regulation, and unlimited temperature, are a quartet of benefits of the electric furnace that make possible a realization of those exceptional qualities so often claimed for and so rarely reached by those cupola-compounded mixtures that are pleased to go under the name of semisteel. Correctly balancing the combined and uncombined carbons also is a matter of no great intricacy in the electric furnace by the vicarious means of the silicon content. Indeed, the capricious vagaries of the cupola with reference to carbon control, are replaced in the electric furnace by substantial certainties.

Low Oxidation Loss

Another advantage accruing from the electric furnace is the possibility of making furnace additions of manganese and other elements for particular purposes, without having to expect more or less appreciable losses; the manganese losses are *nil.* Other benefits there are, but they are of a well-known order, so that their repetition here would be commonplace. The one big advantage from the standpoint of composition is the absolute control of mixture, making duplication of results more a matter of correct calculation and less the effect of happy accident.

A concrete example of results actually obtained in everyday running practice may be of interest. A rather ordinary mixture of pig iron and foundry scrap was melted as usual in the cupola, transferred to a basic electric furnace and there superheated and refined under a lime slag. The untreated iron was of a composition regularly giving standard "arbitration" test bars that broke under an average transverse load of 2950 pounds with a deflection of 0.10-inch. After treatment in the electric furnace, the iron gave the same kind of bars breaking at slightly over 4400 pounds and a deflection of 0.115-inch. The specific gravity was increased from 7.10 to 7.25. About 25 minutes was the time of the electric furnace treatment, and the current consumption was 104 kilowatt-hours for 2000 pounds of iron.

Specific Recommendations

At the beginning of the paper the author indicated several concrete cases which seemed to justify this proposed dual process, and now before closing he wants to define broadly some classes of iron castings for which it may be feasible. In the first place, there are those castings for which there is exacted unusual tenacity, solidity and other physical properties. Secondly, there are those castings that are difficult to run on account of having thin sections and relatively large sizes. Thirdly, there are those castings of high quality whose extreme foundry cost is but a very small part of the total cost of the finished article. For the moment, leaving the cupola, attention may well be called to possible advantages in using the electric furnace in connection with the "direct metal" from the blast furnace, [illegible]ectric furnace filling the tripl[illegible] mixer, superheater and refi[illegible] process would make possible [illegible]s gray-iron castings almost direct from the blast furnace at a cost very little higher than that of ordinary cupola iron.

To conclude, the author wants to emphasize the fact that the cupola and electric furnace duplex process for gray iron is not recommended by him as a commercial practicability for ordinary iron castings under ordinary circumstances, but rather as a convenient and extremely efficacious substitute for the cupola process for extraordinary castings or for extraordinary circumstances.

The Fire Proof Shoe Co., Jackson, Mich., has been organized and will start operations about the middle of September. This company will manufacture patented asbestos molders' shoes, leggings, etc., which they will sell direct to foundries desiring them.

Modern Gray-Iron Foundry in Utah

In Order to Keep the Mills, Mines and Smelters of a Large Copper Company Going During the War This Shop Reached a Monthly Production of 900 Tons

By T F JENNINGS

WHEN Kipling wrote the famous lines "east is east and west is west and never the twain shall meet" he did not foresee the tremendous changes that were to take place in a few years Trade and commerce have leveled barriers that at one time seemed insurmountable Captains of industry have set up their factories and installed their processes in strange lands Particularly is this true of the casting industry. There are still differences of speech, clothing, customs and manners among the people of the different nations but the methods of producing castings are rapidly becoming identical everywhere

Consider the case of the American west Up to a few years ago, and even yet in the minds of some people the names, Utah Wyoming and California call up visions of buffalo herds and prairie schooners, Indians and gold hunters, Mormons and Danites blood and gold and violent deaths, all enveloped in a haze of sage brush and revolver smoke As a matter of fact such things have not only passed away, but they have passed out of peoples minds in the west, if they are recalled it is in the same way that people in the east recall stories of the Pilgrim Fathers and the Boston Tea Party.

The geographical distinction still remains, but there is no east and west as far as industrial life is concerned The ubiquitous molders foundrymen and molding machine manufacturers have found their way into every place where castings are needed They have built shops, set up their machinery and proceeded to turn out castings in as matter of fact way as any foundry in Boston town where castings have been made almost since the days of Miles Standish Indeed there are foundries not only in Boston but in other old and long established communities which cannot compare either in size, convenience, equipment o output with the Arthur foundry of the Utah Copper Co, located at Garfield, Utah

This shop has increased remarkably in size and production during the past 8½ years In 1910 it was located in a small poorly lighted, and ventilated building 61 x 62 feet, which had been taken over from the Boston Consolidated Co Outgrowing this small building, a new shop was completed in the early part of 1911 which measured 80 x 120 feet The demand for castings for the copper smelters and the building of the Bingham & Garfield railroad increased the work to such an extent that the foundry was extended 75 feet in 1912, 30 feet in 1915 and 90 feet in 1917. At the present time the main building of the foundry covers an area of 80 x 315 feet, after allowing space for the chipping room, coreroom and cupolas there remain approximately 16,000 square feet of molding floor.

The foundry building and equipment is modern in every respect making working conditions ideal. As may be noted in Figs. 1 and 3 light and ventilation have been amply provided for.

At the back of the foundry the iron and coke yard is on a level with the charging floor. Concrete bins are arranged on this yard to hold pig iron, coke, scrap and molding sand. The floor of the bins slope gradually from the railroad track to the charging floor which simplifies to a great extent the unloading of the cars. All the material in the yard is handled by a 20-ton electric locomotive crane. It is equipped with a magnet and besides unloading all the material it

FIG 1—72 x 72-INCH JAR ROLL-OVER PATTERN DRAWING MACHINE EQUIPPED FOR MAKING CASTINGS SHOWN AT *A* NOTE THE SPECIAL TYPE OF STAND AT *B* FOR HOLDING THE CHEEK

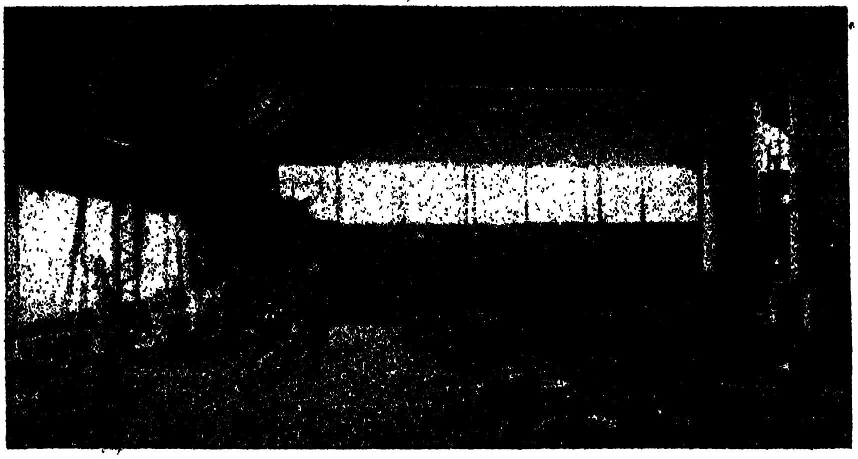

FIG 2—COKE BUNKER AND CHARGING FLOOR. THE BUNKER IS FILLED WITH COKE THROUGH HATCHWAY IN THE ROOF

handles the drop ball for breaking scrap. Coke is loaded in large boats which the crane dumps into a bunker on the roof of the charging floor. This bunker and the chutes leading down from it are clearly shown in Fig. 2. The crane is also used for removing waste from the chipping room, cupolas, etc.

The brass foundry is located in a separate building from the iron foundry. It is equipped with three oil-fired furnaces having a total capacity of 9000 pounds per day. The brass castings vary in weight from a few ounces to 800 pounds and in quality from plain yellow brass to the best grades of bronze and aluminum alloys.

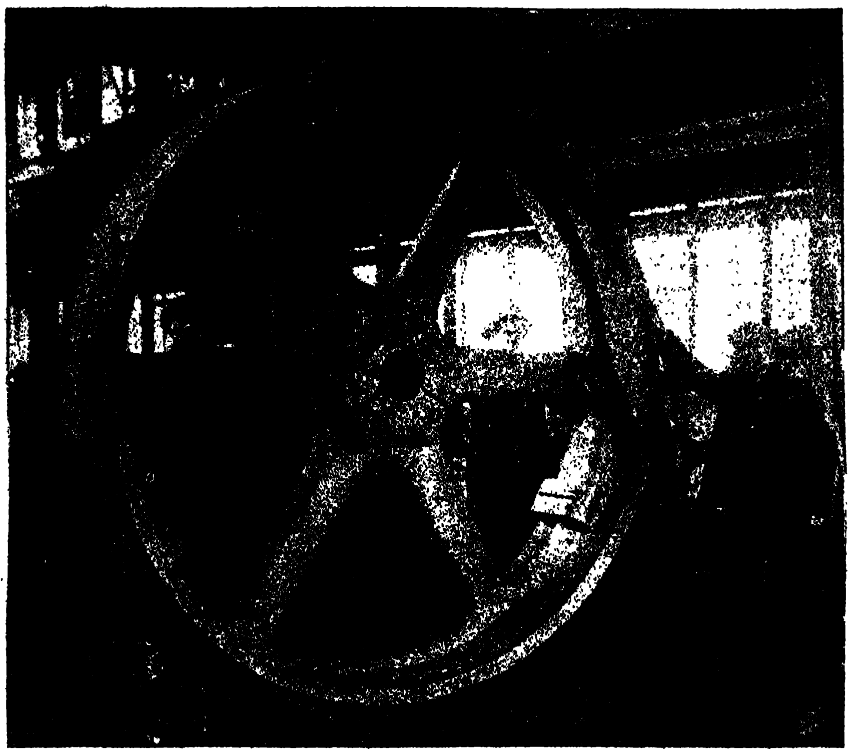

FIG. 3—A 10-FOOT SPLIT PULLEY CAST IN GREEN SAND WITH DRY SAND ARMS AND HUB—T. F. JENNINGS FOUNDRY SUPERINTENDENT AT EXTREME RIGHT

The main bay of the iron foundry is served by two 15-ton electric traveling cranes running the full length of the building. There is a 3-ton electric traveling crane in the side bay and two jib column cranes of 2000 and 3000 pounds capacity, respectively, in the coreroom. There are three core ovens provided for drying the cores, one car oven and two large five-drawer, modern, oil-fired ovens.

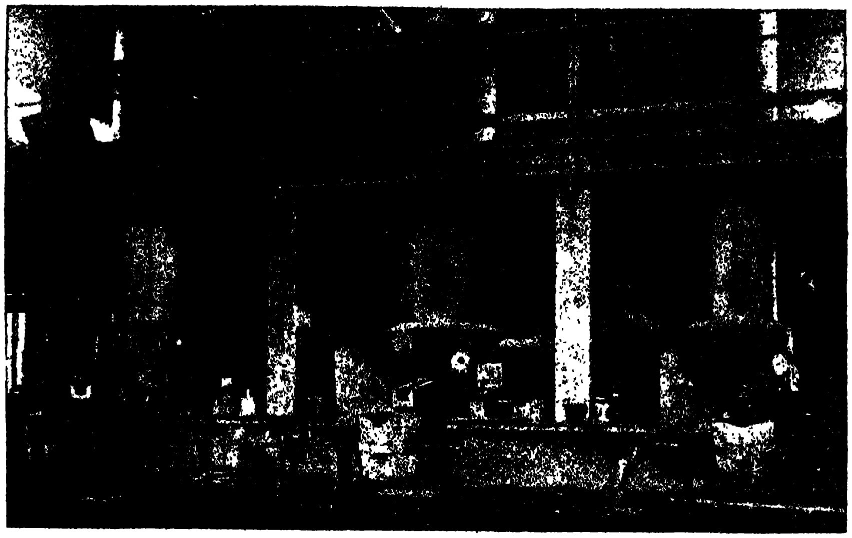

FIG. 4—A BATTERY OF THREE CUPOLAS. NOTE THE CONCRETE WALL ACROSS THE FRONT OF ALL THREE

The melting equipment in the gray-iron foundry consists of three Whiting cupolas, Nos. 3, 5 and 7. Their combined melting capacity is in excess of 150,000 pounds per heat. The blast is furnished by three Western Electric centrifugal air compressors and the blast pressure is registered with two Clark blast meters.

The blower room, which [illegible] of concrete, measures 44 x [illegible]s. There is a 47-foot wall 4 feet ~~high~~ in front of the cupolas which prevents the drop from spreading around the shop floor. The cinders and shop waste are loaded into large boxes and moved through the end of the shop. When the boxes reach the outside they are loaded on a car by a Link-Belt electric hoist and carried to the dump.

The charging room is built of steel and concrete. The floor has a concrete base with square wooden blocks set on end and wedged with asphaltum. The roof is 20 feet above the floor, and the back wall, which is open for one-half the height, extends the complete length of the charging floor. The general features of the charging floor are clearly shown in Fig. 2.

The molds are made by hand and

also [illegible] molding machines of the latest type. One Herman jar-ram rollover pattern drawing machine, 72 x 72 inches, with pattern, mold and some of the castings produced on it is shown in Fig. 1. There are six other molding machines of various types and sizes used in different parts of the shop. The production of castings has increased from a few thousand pounds per month in 1910 to 1,800,000 pounds in October, 1917.

When the castings are cleaned they are taken from the chipping room on cars which pass over scales where the weight is noted. They are then delivered to the plant machine shop or to the casting stockyard and loading dock from which shipments are made to the various plants of the company. Castings are made of five different grades of metal. Tube mill liners are made of manganese steel.

The working force varies with conditions. It touched the highest point in October, 1917, when a total of 240 men were employed in and around the foundry.

The company operates its own pattern shop. It is 30 x 60 feet with continuous windows around the sides and front. It is provided with eight work benches, six layout boards, two jointers, one band saw, two lathes; one sander, two glue heaters and three trimmers.

In 1916 a new pattern storage was built, 124 feet in length, 64 feet in width and 41 feet high. It is three stories in height and fully equipped with pattern racks throughout. At the present time over 10,000 patterns are stored in this building.

The company's desire for the safety and welfare of the foundry employes is never lost sight of and its accident [illegible]ng is remarkably low. There h[illegible]n a serious accident of any k[illegible]r to workmen or equipm[illegible]e past three years.

Local Committees for Foundry Convention at Philadelphia

The convention and exhibition of the American Foundrymen's association at Philadelphia will easily exceed in size and importance any previous affair in the history of the association. A glance at exhibition figures of previous meetings shows that in 1916 at Cleveland 38,000 square feet of space were occupied by the exhibits, 1917 at Boston, 44,000 square feet, and in 1918 at Milwaukee, 42,000 square feet. As early as Aug. 10, 1919, the huge total of 60,000 square feet had already been reserved by exhibitors for this year's big foundry equipment show at Philadelphia.

Special entertainment features also are now being arranged by the local committees with the aim of making the social features of the convention unusually attractive. Thomas Devlin, the veteran president of the Philadelphia Foundrymen's association, is chairman, *ex officio* of all committees, and Howard Evans of the J. W. Paxson Co., Philadelphia, is general secretary.

The members of the various local committees are as follows:

Clearing House Committee

Howard M. Bougher, Chairman, J. W. Paxson Co.
Charles W. Asbury, Enterprise Mfg. Co.
H. J. Bannister, George Oldham & Son.
G. H. Clamer, Ajax Metal Co.
Stanley G. Flagg III, Stanley G. Flagg & Co.
D. P. Hopkins, U. S. Cast Iron Pipe & Foundry Co.
W. J. Johnson, Baldwin Locomotive Works.
George C. Matlack, William Cramp & Sons Ship & Engine Bldg. Co.
Staunton B. Peck, Link Belt Co.
Charles Suess, Westinghouse Elec. & Mfg. Co.
Walter Wood, R. D. Wood & Co.
Thomas Kaveny, Herman Pneumatic Machine Co
Frank Hodson, Elec. Furnace Construction Co
Silas M. Tomlinson, Frank Samuel.

The chairman of each of the following committees is also a member of this committee.

Information Committee

George F. Pettinos, chairman.
Cyrus Borgner, Cyrus Borgner Co.
W. T. Dunning, Chester Steel Casting Co.
H. A. Ross, Ross-Tacony Crucible Steel Co.
Joseph E. Stutz, Thomas Devlin Mfg. Co.
R. C. Thum, Aetna Foundry Co.
W. G. Summers, Phoenix Iron Co.
W. J. Coane, Ajax Metal Co
J. C. Childs, Austin Co.
J. H. Schwacke, William Sellers & Co
T. C. Voorhees, Hickman, Williams & Co.

Reception and Hotel Committee

Hon. W. C. Sproul, governor state of Pennsylvania, honorary chairman
Hon. Charles M. Schwab, vice chairman, Bethlehem Steel Co.
H. W. Brown, acting chairman, Tabor Mfg. Co
G. H. Clamer, Ajax Metal Co
George C. Davis, Chemist.
E. S. Dailey, William Adams Foundry Co.
Edwin Elliot, Midvale Steel & Ordnance Co
J. S. Hibbs, J. W. Paxson Co.
W. S. Quigley, Quigley Furnace Specialty Co
W. H. Ridgway, C. Ridgway & Sons Co.
W. J. Sherman, Foundry Dept. Bethlehem Steel Co.
E. M. Taggert, J. W. Paxson Co.
C. H. Wollaston, Lobdell Car Wheel Co.

Visitation of Plants

George C. Davies, chairman, Pilling & Crane Co.
S. J. Creswell, S. J. Creswell Iron Works Co
H. E. Mandell, W. W. Lindsay & Co.
S. W. Mitchell, Philadelphia Roll & Machine Co.
Walter T. MacDonald, Fletcher Works, Inc.
C. H. Newcomb, Crocker Brothers
F. J. Ryan, American Metallurgical Co.
George Somerhalder, Westinghouse Elec. & Mfg. Co.
H. B. Taylor, George F. Pettinos.
S. R. Vanderbeck, Whiting Foundry Equipment Co.
E. J. Decker, Paul S. Reeves & Son.
Thomas Holt, Camden Foundry Co.
George Fox, Philadelphia Sash Weight Works
F. E. Schwarze, Cleveland Pneumatic Tool Co.
A. G. Hauck, Philadelphia Fire Brick Co.
A. F. Kempe, W. J. Rainey, Coal and Coke.

Publicity Committee

C. R. Spare, chairman, American Manganese Bronze Co.
H. A. Bomberger, Verilite Metals Co.
T. Harold Brown, E. E. Brown & Co.
J. W. Graham, Kitson Co.
Charles E. Pettinos, 802 Abbott building.
A. G. Warren, J. W. Paxson Co.
E. Arthur Bernstein, Bernstein Mfg. Co.
Charles E. McEvoy, H. A. May Foundry Co
George M. Beikert, Fairmount Foundry Co.
H. W. Gledhill, Shepard Elec. Crane & Hoist Co.
H. E. Heneszey, Carborundum Co.
H. J. Winters, T. P. Kelley & Co.
H. L. Haldeman, Pulaski Iron Works.
W. E. Wallace, Matlack Coal & Iron Corp.
M. R. Taggart, J. W. Paxson Co.

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C. T. Bird, Pangborn Corp.
Thomas M. Eynon, Eynon-Evans Co.
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W. W. Hearne, Matthew-Addy Co.
W. S. Hallowell, Harrison Safety Boiler Works.
Charles E. Auend, Haines, Jones & Cadbury Co.
J. Harry Mull, William Cramp & Sons Ship & Engine Bldg. Co.
J. T. King, Harbison & Walker Refract. Corp.
E. H. Redmond, Fairmount Foundry Co.
James S. Stirling, Hilles Jones Co.
George R. Sullivan, Rogers, Brown & Co.
Josiah Thompson, J. Thompson & Co.
C. K. West, General Electric Co.
W. J. Davis, McHatton Foundry Co.
S. E. Hadley, W. W. Sly Mfg. Co.

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Frank Krug, chairman, White & Brother.
R. R. Belleville, Dixon Crucible Co.
C. D. Matthews, Camden Iron Works.
A. J. Myer, Abram Cox Stove Co.
F. J. Ryan, American Metallurgical Corp.
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Frank Orem, Federal Steel Foundry Co.
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Golf Committee

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J. R. Neilson, Ajax Metal Co.
I. U. Park, Park & Williams.
C. B. White, White & Bro.
H. F. Rebmann, American Engineering Co.

Loan of Automobiles

Herbert J. Bougher, chairman
C. M. Benkert
C. F. P. Buckwalter
Wilfred Lewis
Charles E. McEvoy
Wesley Caskey
Capt. J. L. Crawford
W. F. Sauter
H. A. White
Howard Evans
C. M. Trivett
G. H. Clamer
Otto W. Schaum
F. L. Webb
George F. Pettinos
M. L. Kim
H. W. Brown
C. P. Pond
C. B. White
J. W. Paxson Co.
J. D. Johnson, Jr.
J. H. Sheeler
H. M. Bougher
H. F. Rebmann
Thomas Devlin
R. C. Thum
Frank Hodson
F. B. Pitt
W. H. Ridgway
J. H. Golding
A. G. Warren

Gas Holes in Malleable

By H. E. Diller

Question.—We find small holes, about pea size, in our malleable castings from two patterns. Both castings have the inside cored out with a dry sand core. The cores have a ¼-inch vent which is taken through the cope from the top of a coneshaped print above the core print. Please advise us what we can do to prevent the blow holes.

Answer.—From your description we would judge the trouble is that your cores gather moisture, or that your iron is too low in carbon.

To avoid the first difficulty it would be necessary to be sure the cores are used reasonably soon after they are baked and not allowed to stand in the mold any considerable length of time. Should this not be practical a rosin core could be made which would not take up moisture.

If the trouble is with low carbon in your iron, this will have to be overcome by melting in a less oxidizing atmosphere, which means the use of less air. The carbon is low enough when it is down to 2.50 per cent and care should be taken to see that it does not run much below this in any part of the heat. The writer has seen heats that have been so highly oxidized that, the last iron contained 0.50 per cent less carbon than the first iron.

Institution of British Foundrymen

Report of First Meeting of the Old British Foundrymen's Association Under Its New Name—Papers on Sands, Molds and Patterns Presented—The President's Address Deals With Labor Problems in England

By JOSEPH HORTON

FOR many years the leading organization of foundrymen in the United Kingdom has been known as the British Foundrymen's association. At the sixteenth annual meeting held in Liverpool, July 17 and 18, it was announced that the society hereafter will be called the Institution of British Foundrymen. It also has been decided to apply for a charter of incorporation. About 80 members from all parts of the kingdom were present at the Liverpool convention.

John Little, Manchester, president of the association, occupied the chair during the meeting. Among those present were T. H. Firth, the retiring president; M. Riddell, vice president, and the following past presidents: R. Buchanan, F. J. Cook, W. Mayer and J. Ellis, together with a number of members of the general council. The meeting took place in the Royal Institution, Colquitt street.

The annual report of the council showed a total membership of 1544, compared with 1058 at the time of the previous annual meeting. This is much the largest increase in the history of the association. The establishment of a new branch at Coventry, now having a total membership of 226, is largely responsible for this increase, but all the nine branches show gratifying growth, Birmingham coming second in this respect with an advance from 138 to 189 members. J. E. Hurst, Manchester, was appointed to represent the institute on the British Engineering Standards association's committee on cast iron and will report to the general council. Prof. H. C. H. Carpenter, London; Prof. A. Campion, Glasgow, and Professor Rhead, Manchester, were elected honorary members of the association in recognition of their valuable services to the foundry industry and to the association.

In his address, which was delivered at the opening session, the president, John Little, dwelt largely on the labor question which at present is so vital not only in England but in every country in the world. Attention was called to the temptation for the nation to rest. Mr. Litle said in part:

> Rest at this juncture would be fatal to our best interests. It is precisely what the enemy would most like to see. Hostilities in the field are over, thank God, but the fabric, the shattered fabric of our industrial system must be rebuilt, not entirely on the old lines, but rather in accordance with the special requirements of the new era, the dawn of which we have been permitted to witness. Presently we may be able to take things easier. That moment, however, is not yet. Today and tomorrow we must continue the struggle, and upon our ability and determination to do so depends the real victory of the past five years' struggle. We are passing through a phase of industrialism absolutely without parallel. We are in the midst of a revolution, before the mysterious forces of which old ideas cannot stand, and in the economy of which many time-honored methods and institutions are finding no place.
>
> One of the most important problems of reconstruction is that of labor. What can be done to increase the supply of skilled men, and to insure that within a generation the ranks of working foundrymen shall be brought up to the fullest possible strength, every man bearing the hall mark of proficiency? Compared with other sections of the iron and steel industries, molders' wages stand very well indeed. In spite of that, however, there has been for many years, even in prewar days, a danger of lowering the standard of efficiency. What is responsible for this serious state of affairs? In my opinion, and I have been in a position to observe, the trouble begins at the very base. It begins with the system of apprenticeship, or rather, the lack of it.
>
> How many youths and men are there in the foundries today who are scarcely able to write their names legibly, or read a drawing? It is a deplorable state of affairs and cries loudly for rectification. The remedy, I believe, is not far to seek. Let the old system of binding a lad as an apprentice be restored. If possible let him remain at day school until the age of 16 years, but, in any case, as soon as he has become apprenticed arrangements should be made for him to continue his schooling by attending classes a certain portion of each day on his employer's time, with no deduction from his wages. You cannot reasonably expect a lad to leave his day's work in the foundry and of his own free will, passing by his companions on pleasure bent for the evening, commence studies at night classes. Some will do it, and even eagerly in their determination to progress; but they are in a minority, and it is the majority we have to deal with in such a question as this.
>
> Let me once more emphasize the gravity of the question of output. We must preach it in season and out of season. The hope of our industrial future is bound up with it. The output per man must be greatly increased, or we are nationally lost. No reasonable employer disagrees with a man's wage-earning power being increased, nor with the shortening of the hours of labor, but failure to at least maintain the output of this country's shops will play right into the hands of foreign competitors and lead to the ruin of the bright prospects now open to us as a result of the great victory of the allies. It is no use for us to turn our faces from the truth. Labor today is being made the victim of influences which are inimical to the general happiness and prosperity of the nation. We appeal to the uprightness and common sense of the genuine British worker and urge him to awaken to a sense of the actual position of things, to discern between the truth and deception, before it is too late to do either the one or the other.
>
> We have just seen the treaty of peace signed, and now commences a great international fight for trade under reconstructed industrial and commercial conditions. It will require every ounce of energy and sound common sense to pull off a victory, but as certain as night follows day there will be no middle course.
>
> We are in this new campaign for a plain issue, industrial and commercial life or death, and the man, or section of men, neglecting the least opportunity of assisting the country to win is a traitor.

Several papers were read during he conference and each one was thoroughly discussed by a number of members who gave their individual experiences and viewpoints. Prof. P. G. H. [illegible]well, Liverpool university, Liverp[illegible] a paper in which he compares [illegible]g sands of Great Britain an[illegible]ca. Professor Boswell's remarks in regard to molding sands in United States were based largely on his study of American foundries while visiting this country in the fall of 1918 at the request of the British ministry of munitions. This paper brought out a general discussion in which W. Mayer, F. J. Cook, T. H. Firth and President John Little took part. It is published on another page of this issue of THE FOUNDRY.

In reply to questions, Professor Boswell said that he had intended to give a good deal of information as to physical tests, but he had been unable to complete a number of analyses which he commenced last February. He had always held, he said, that chemical analyses of themselves are of little use and foundrymen complain very justly that such analyses give them no practical information. With regard to sand mills, those used in America are large, with rollers in some cases weighing up to 500 pounds. Dr. Boswell, however, said he is opposed to large mills, and he supported those in the meeting who advocated the general use of small mills. In Belgium, relatively small mills are used with light rollers. It is quite a common practice to have one of the mills fluted, so as to assist in breaking up the sand as completely as possible. Dr. Boswell thinks a small mill, say 2 feet 6 inches by 3 inches, is satisfactory. Although he saw very large mills in the states he never found any reason to favor any of that class of machinery.

In discussing J. E. Hurst's paper on permanent molds and centrifugal castings, S. J. Smith said that in the preparation of the dies, he aims to get a high combined carbon and has found considerable difficulty in getting the metal sufficiently hard. But he has also found that it is possible to get the combined carbon a little too hard for machinability. He said he was very glad to hear from Mr. Hurst that it is possible to produce as many as 2500 castings from a single die, but his own experience is that an average of from 1000 to 1500 nonferrous castings are obtained from a die. He does not think there is a better metal for dies than cast iron. In die casting there is more difficulty in getting away the air from a die than from a sand mold, and special provision must be made for its exit. If a die is found very troublesome in this respect, the best thing to do is to scrap it and make another.

Life of the Mold

E[illegible]ook said one of the difficulties a[illegible]n regard to the maintenance [illegible]of such articles as small pisto[illegible]s entirely to the life of the mold. About 500 castings represent the capacity of an ordinary permanent mold, probably due to the rapid casting. If a longer time were allowed for casting it might obviate the difficulty, but if only 15 seconds is allowed the mold would become overheated. One of the outstanding features is the size of the grain of the metal of the mold and that is of more importance than the amount of the combined carbon. The silicon content is also very important, because of the breaking up of the pearlite structure. With 1.25 per cent instead of 1.50 per cent silicon, as mentioned by Mr. Hurst, the life of the die is materially improved.

The final paper of the meeting was by H. Sherburn Warrington, on the production of pattern plates for repetition castings. The afternoons were spent in visiting places of interest near Liverpool. On Thursday afternoon, July 17, the works and shipbuilding yards of Messrs. Cammell, Laird & Co., Birkenhead, were inspected at the invitation of the managing director, Sir George Carter. In the evening a dinner was held for the members at the Exchange Station hotel. On Friday afternoon the village and works of Lever Bros., Ltd., Port Sunlight, were visited. There was also an excursion to Southport and some of the members visited one of the Atlantic liners in dock.

Pattern Manufacturers Hold Convention

The second annual convention of the National Association of Pattern Manufacturers was held at the Statler hotel, Buffalo, Aug. 16 and 17. The roll call disclosed the fact that there were representatives present from 26 different branches.

President E. F. Ball delivered the opening address. He said the year just past had been an eventful one and might be referred to as a period of waiting. Before the signing of the armistice, business had been in a more or less chaotic state; and since the armistice had been signed conditions in the pattern making and other fields had not improved to any appreciable extent. He touched on recent labor troubles from the standpoint of the association and made several suggestions and recommendations for their elimination in the future.

A resolution to the effect that the interests of the association would be advanced through the members cultivating a spirit of trust, fairness and co-operation or, in other words, an observance of the golden rule in all their dealings with each other, was adopted unanimously.

At the Saturday afternoon session the convention committee submitted its report. After some discussion it was decided to hold the 1920 convention in Toledo, O., on the second Friday in August and the day following. Several other questions of interest to the association were taken up and disposed of.

The resignation of A. H. Poole as a trustee was accepted and regret expressed that he had found it necessary to sever his official connection with the board.

All the retiring officers were reelected unanimously. The personnel for the ensuing year will be: President, E. F. Ball, Newark Stamping & Foundry Co., Newark, O.; first vice president, Vaughn Reid, City Pattern Works, Detroit; second vice president, J. W. Brost; secretary-treasurer and business manager, E. O. Melville, Melville Bros., Columbus, O.

Trustees were elected for one, two and three years as follows: S. H. Thompson, S. H. Thompson Mfg. Co., Dayton, O., for one year; J. H. Bridge, Maumee Pattern Co., Toledo, O., two years, and A. E. Schuchert, A. E. Schuchert Pattern Works, Cincinnati, three years.

The Buffalo branch provided entertainment for the visitors. On Saturday afternoon the ladies were taken for an automobile ride around the city and environs. At 7 p. m. a banquet was held in the banquet hall of the Statler hotel, at which an address was presented by D. D. Fennell, general manager, Belmont Rubber & Packing Co., Buffalo. The speaker made a strong plea for closer personal relations between employer and employe. On Sunday the party boarded special trolley cars for a sightseeing tour of Niagara Falls.

New England Foundrymen Visit Providence

Nearly 200 members of the Nev England Foundrymen's associatio held their annual summer outing o Aug. 13 and were treated to a shor dinner at the Pomham club, Providence, R. I. The association hold outings occasionally for relaxation an for the purpose of having a goo time. The entertainment committe provided automobiles to convey visitors from the station to the club which with its grounds and accessories was turned over for the day t the foundrymen. Late in the afternoon, having concluded an informa program of music, etc., the member departed for the West Side club o Providence where further entertainment and refreshments were provide

Facts About Blowers

Much valuable information on rotar positive blowers, gas exhauster pumps and vacuum pumps, coupling blast gates, relief valves, feed devices and governors is contained in bulletin issued by the P. H. & F. M Roots Co., Connersville, Ind. Complete tables giving sizes best fitte for various uses with capacity, speed and other data useful to the enginee feature this bulletin. The principl utilized in the impellers and blower made by this company is clearly se forth. Many illustrations assist i making plain the text.

An alloy for making jewelry consists of gold, 74 parts; platinum, 4 parts and palladium, 21.5 parts. It i similar to platinum in appearance.

Compares Molding Sand Practice

English Geologist and Molding Sand Expert Sent to America During War by Ministry of Munitions Discusses Molding Sands and Foundry Practice of Britain and America

By PROF. P. G. H. BOSWELL

A Competent Critic

PROF. P. G. H. BOSWELL, author of this article, is head of the department of geology, University of Liverpool, England. It is in the molding sand field, however, that he enjoys special distinction, having devoted a large portion of his life to a study of sand problems. In this connection he has engaged in much research work and has personally visited many of the world's deposits of sand and studied their individual characteristics and bonding qualities. During the war the British Ministry of Munitions retained Dr. Boswell's services to investigate molding sand practice in British foundries. Later he was sent to America to study the sands of this country. In this paper, which he delivered before the British Foundrymen's association at its annual meeting in Liverpool in July, Dr. Boswell compares American and British sands and discusses the practices in vogue in the two countries.

THE writer visited the United States in the fall of 1918 at the request of the British ministry of munitions to make a study of, and report on, the use of molding sands in that country. The saving which might be effected by the use of ideal sands in metal castings amounts to many millions of dollars each year.

The problems involved in the successful founding of iron and nonferrous metals and alloys, such as copper, aluminum, bronzes, brass, light alloys, etc., are due in a less measure to the molding sand used than in the case of steel. The temperatures reached in casting these metals and alloys rarely exceed 1250 degrees Cent., whereas steel might be, and is, frequently run at temperatures approaching 1700 degrees Cent. The foundry practice studied by the writer in the United States and Canada mainly dealt with steel-production; incidentally, iron and brass foundries were visited, especially where they accompanied steel foundries in the same or related works. The following comparison, therefore, deals mainly with steel-production.

Rolling Mills Use Steel

The enormous steel output of the United States is largely produced for rolling mills, and stamping and forging shops. It takes, therefore, chiefly the form of plates, sheets, bars, rails, stampings and forgings. The output of castings is considerably less in volume and the steel foundries, like the iron and brass foundries, are often merely adjuncts to the rolling mills and forging shops. In such cases the foundries produce big quantities of wheel-centers, housings, rolls, and other machine parts to replace those which become worn or broken. A large proportion of the work carried out in the remainder of the steel foundries consists of locomotive castings, the upkeep and rapid growth of the extensive transportation systems of America having necessitated the development of numerous big foundries. In many cases the output of the foundry is employed entirely for the works' own use.

Small jobbing shops which turn out castings of a miscellaneous character and often of variable size, appear to be considerably less abundant in America than in Britain. An attempt has been made to standardize and combine a number of these smaller works. It is perhaps early yet to judge of the success of the venture.

It is common knowledge that considerably more basic than acid steel is produced in America and the tendency towards the further reduction of the acid output is very marked. Castings are produced from both basic and acid steel, but the output of acid steel castings shows a tonnage about one-third greater than that of basic steel castings. About three-quarters of the tonnage of the steel used for castings is produced in open-hearth furnaces.

Green-sand molding is much less common in America than in Britain, and is reserved for small work. It is more frequently practiced in the Middle West than in the Eastern states. The unwillingness to make green-sand castings might be attributed to the sands used, which are perhaps more suitable for dry-sand work. It would, however, be difficult to sustain this objection, and, in short, it is the opinion of the writer that American green-sand molding falls, in the matter of foundry technique, behind the British practice.

Types of Molding Sands

The sands used for the casting of iron, brass, etc., require and receive only incidental attention. Erith (or Thames) sand was actually imported, though quite needlessly, into America before the war. The famous sand from Albany, N. Y., is strikingly similar to Erith sand in analysis, texture and behavior, and like the latter, is used in the casting of iron, bronze and brass. For heavy iron castings, local sands of fairly coarse grade are utilized. One of the most popular in the Eastern states is that from near Millville, N. J., known as "New Jersey gravel." Others, also from the same state, used for the casting of brass, are known as Lumberton and Howall sands respectively. Cores are prepared for brasswork from a fine silica sand such as that worked for glass-making in Pennsylvania, bonded with oil. None of the above mentioned sands are sufficiently refractory fo steel-casting, and most of t[illegible] are also unsuitable in grade.

No sands are found in [illegible] States similar to our wides[illegible] valuable deposits of Bunter age (Birmingham, Kidderminster, Mansfield, Wolverhampton, Stourport, etc.), which are the backbone of our foundry san industry, so far as iron, brass, etc., ar concerned. These sands have a markedly rich red color, resulting from the ferruginous bond, and also possess characteristic chemical and mechanical constitution.

Molding-sands used for the casting of steel may be divided roughly into two classes:

(*a*) Those in which the natural clay bond is sufficiently strong in itself fo foundry purposes;

(*b*) Those requiring the addition o fireclay and some artificial bond, such as molasses, flour, dextrin, oil, etc., t yield a strong structure.

Throughout the British area, th

sands [illegible]ed are almost without exception those falling into the first class. On the other hand, the practice most widely adopted in America is to use artificially bonded silicia sands. Only in the Eastern states, where supplies of naturally-bonded steel-molding sands are found in New Jersey, is the practice similar to our own. Even in New Jersey no sands have been found which carry a bond so strong or so highly ferruginous as that of our high-class western European molding-sands such as Belgian red, Belgian yellow, French red, French yellow, etc.

Excluding certain scattered and relatively less important foundries, we may group steel-founding in the United States into three chief areas:

(*a*) The Middle West, the chief centers of which are Milwaukee, Chicago and St. Louis. High-silica sands, artificially bonded, are used exclusively in this region.

(*b*) The Ohio-Pittsburgh area, where sands from Ohio and Pennsylvania are mainly used. The sands are high-silica sands, but are not so pure as those used further west. They carry a slight natural bond, but not sufficient to bring the silica content below 95 per cent. Artificial bonds are necessary to give them the required consistency and strength.

(*c*) The Eastern seaboard, including particularly the areas around Philadelphia, New York, and Boston. In the matter of the sands used, Montreal and Nova Scotia may be considered to lie in this belt. The molding sand employed is almost exclusively New Jersey sand, which has a moderately strong natural bond. The silica percentage is much higher, however, and the alumina percentage lower than those of British used materials (SiO_2, 80 to 89 per cent; Al_2O_3, 4 to 9 per cent). The sands are less ferruginous, the smaller percentages of ferric oxide and alumina accounting for the weaker bond. Occasionally the New Jersey sands are used in the American foundries without the addition of an artificial bond, but in most cases molasses, flour, dextrin or other compounds are added to the sand.

New Jersey sands are also transported to the Pittsburgh area mentioned under (*b*) above, but their use is not extensive in that area on account of the high expense of transporting them.

The outstanding difference in practice on the two sides of the Atlantic, therefore, hinges upon the use of artificially bonded high silica sands. Among the sands most extensively employed for this purpose are the well known deposits worked for glassmaking, abrasive and other purposes by many companies near Ottawa, Ill. To a much smaller extent, other sands, such as those from Pacific, Mo., northern Pennsylvania, etc., are used.

The Ottawa sand is white or pale-

Comparison of Naturally and Artificially Bonded Sands

1.—*A better finish is obtained upon the castings, especially if the bond is ferruginous, when a sound, smooth, blue skin is obtained. The casting strips freely even when hot.*

2.—*In the present practice fewer troubles, like scabs, blowholes, and burning-on are experienced.*

3.—*The bond is stronger when wet.*

4.—*The sand is not easily standardized and made fool proof. It is liable to considerable variation in the field, and consignments often differ in composition.*

A skilled workman is required at the mill to mix the sands properly, to keep the composition constant, and to mill the product for the correct period of time.

5.—*More delicacy is possible in the variation of the composition of mixtures according to the classes of [illegible]k in the foundry (e.g., as many as seven types of [illegible]ng mixtures may be made.)*

[illegible]*On the other hand, too many constituents for [illegible]e work are often present in the mixtures. The number is frequently four and sometimes reaches five.*

7.—*In the chemical analyses of material of different grades present, the sand-grade or high-silica portion is not so refractory as a natural high quality silica sand. The clay grade also is less refractory than the highest quality fireclays.*

8.—*The fine sand, superfine sand and silt are not absent, although in the best sands the proportion is low.*

9.—*The best molding sands carry considerable quantities of colloidal hydrated iron oxide. This compound improves the bond and life of the sand and assists the stripping and soundness of the casting. (See 1, above.)*

10.—*Reclaiming of sand is not easy owing to the considerable quantity of burnt clay present. Less old floor sand can be used in the mixture.*

11.—*The available quantities of naturally bonded sands in Britain are (excepting the less well bonded Scottish rotten-rocks) strictly limited. The reserves of foreign sands are also inadequate; in any case, we ought to be independent of them. The best known naturally bonded sand is from Belgium.*

Artificially Bonded Sands

1.—*The finish is rougher, the surface of the casting having a gray color and frequently being pitted.*

2.—*At present, trouble is caused over scabbing and blowholes.*

3.—*The bond is weaker until the mold is dried. working is therefore not so easy, and molds left standing are more easily damaged.*

4.—*The molding sand is easily standardised and the method practically fool proof. High silica sands almost always run true to sample, as do also the fireclays used In any case, the quantity of the latter is small.*

Unskilled labor can be employed at the mill, and the mixture milled for a given time.

5.—*Less adaptability is shown to different kinds of work.*

6.—*The molding mixture is generally composed of two materials, together with an artificial bond. Rarely, three are used.*

7.—*Both high silica sand and fireclay may be chosen for their chemical composition and exceptional refractoriness to heat.*

8.—*The venting is improved if the separate sand and clay are so selected that silt and fine sand are absent.*

9.—*Colloidal hydrated ferric oxide is practically absent. The bond is therefore weaker and the skin of the casting less good. Stripping is more difficult.*

10.—*The artificial bond burns out, and the amount of fireclay which is calcined is small. A little fireclay is thus sufficient to restore the sand. As much as 80 per cent of floor sand can be used in a new mixture.*

11.—*The available quantities of high silica sands and fireclays are practically unlimited, both in the United States and Britain. Independence of foreign supplies is assured. British resources are as high in quality as those from abroad.*

colored, a chemical analysis of an average sample being as follows:

	Per cent
SiO_2	98.47
Al_2O_3	0.75
Fe_2O_3	0.08
MgO	0.08
CaO	0.21
K_2O	0.06
Na_2O	none
TiO_2	0.05
Loss on ignition	0.47
Total	100.17

The chemical composition of the slime washed from the sand is as follows:

	Per cent
SiO_2	87.21
Al_2O_3	7.50
Fe_2O_3	0.52
MgO	none
CaO	none
Na_2O and K_2O	0.20
	95 43

Remainder mainly water

The chemical analysis shows the sand to be highly refractory to heat, for the silica content is very high and the proportion of alkalies and alkaline earths very low.

The importance of the grade of a molding-sand cannot be over estimated (see "British Resources of Refractory Sands.") The Ottawa sand is well graded and consists mainly of the medium sand grade.

Siliceous Fireclay Employed

The relatively large quantity of material in the coarser grades and the small amount of silt and clay, insure open and well vented sands.

Other silica sands employed in the same way occur at Massillon, O., Phalanx, O., Utica, N. Y., Franklin, Pa., and Millville, N. J. Several of these carry also a small quantity of clay and ferruginous bonding material, which at times reduces their silica percentage to 95 or 96 per cent. Chemical analyses of the Portage and Massillon sands in terms of percentages are:

	Portage Per cent	Massilon Per cent
SiO_2	98.30	96 27
Al_2O_3	0.59	1 70
Fe_2O_3	0.53	0.55
MgO	0.10	0.11
CaO	0.16	0.16
Na_2O	0.04	0 07
K_2O	0.18	0.38
TiO_2	trace	0.12
Loss on ignition	0.12	0.83
Totals	100 32	100 19

Besides the artificial bond, which in most cases is molasses, and less frequently flour, sulphite-lees, or dextrin, a siliceous fireclay is usually added to the silica sands mentioned above. Only a small quantity of this binding clay is necessary, the proportion generally varying from 3 to 7 per cent. The addition of fireclay necessarily lowers the refractoriness of the sand, whereas the presence of the molasses, dextrin, etc., makes no difference. As small a quantity of clay as possible is, therefore, used, and in order that the binding quality may be a maximum, the clay selected is as plastic as possible, consistently with being highly refractory.

One of the most popular bonding clays in use in the Pittsburgh district and on the Eastern seaboard is that from Welsh mountain, Pennsylvania. It is a cream colored or yellowish fireclay, having the following chemical composition:

	Per cent
SiO_2	62.50
Al_2O_3	21.46
Fe_2O_3	1.74
FeO	1.20
MgO	1.13
CaO	0.14
Na_2O	0.19
K_2O	4 28
H_2O +	5.81
H_2O	0.61
TiO_2	1.04
P_2O_5	trace
CO_2	none
MnO	trace
BaO	trace
Ce	trace
Loss on ignition	....
Total	100.19

Fireclays from Illinois are similarly used in the Chicago-St Louis area for bonding purposes. Some of the fireclay seen in the works was so siliceous as to resemble our Scottish "rotten rocks."

The clays are ground to pass through 30-mesh screens before being supplied to the steelworks. They are then added to the sand in the desired proportion and ground for a few minutes with the addition of molasses and water, in a pan mill, the procedure being in that respect similar to our own, but the time of milling being less. The molding mixture when taken from the mill is much less tough than our naturally bonded sands, for the full effect of the artificial binder is not seen until the mold dries. In certain cases no artificial binder is added in the mill; the sand and clay are ground together with water, and the face of the mold when made is washed over with molasses or dextrin water. Molasses water is used in preference to flour or dextrin on account of its lower cost.

The American practice in regard to naturally bonded molding sands does not differ very appreciably from ours. The use of such sands is, however, much more limited. The sands from Portage and Massillon, O., bear a slight bond, but it cannot be compared in strength with that of western European sands. Practically speaking the only naturally bonded sands worked in America are those of New Jersey. The binding material in them is clayey, but not strongly ferruginous; it is therefore less strong than that of Belgian, French or British materials. The bonded sand is milled alone or with a high silica sand in a pan mill. In some works an artificial bond is also added, in other cases a fireclay such as Welsh mountain silica clay is mixed with the sand. The resulting product, in any case, does not attain such a tough condition as that of British sands.

The fat sand, from Messrs. Paxson & Co.'s quarries at Millville, N. J., has the following composition:

	Per cent
SiO_2	82.14
Al_2O_3	8.90
Fe_2O_3	2.15
FeO	0.14
MgO	0.31
CaO	0.19
Na_2O	0.10
K_2O	1.22
TiO_2	0.86
H_2O +	3 03
H_2O −	1.16
Total	100.19

In many respects the Scottish practice of using "rotten rocks," the bond of which is often assisted by the addition of treacle, flour, etc., may be considered as intermediate between the English practice of using natural strongly bonded sands, and the American practice of using high silica sands cemented by fireclay and an organic binder. The Scottish rotten-rocks are soft sandstones largely composed of quartz, but carrying also a certain proportion of micaceous and china-clay products, which have resulted from the decomposition of feldspar grains once present in the rock. The clayey material provides a certain amount of bond, but as it is insufficiently strong, the rock is milled with a small quantity of fireclay and sometimes an organic binding material. In most cases the latter is diluted treacle. It is noteworthy that, as in America, steel-castings made in these sands possess a gray skin and do not strip so freely or readily as those made with facing sands carrying a ferruginous bond.

Core Making Practi[illegible]

Coal or sawdust is o[illegible] used, in the same manner as [illegible], for opening up and venting a steel molding sand. The use of either material is not widespread, venting being generally obtained by the admixture of coarser high silica sand.

The practice in coremaking varies in the United States as it does in Britain. In some cases a high silica sand bonded with oil is used, in others the bond is rosin. Silica flour was often added to the core mixture, and a sand for use between the teeth of wheels consists similarly of a mixture of high silica sand and silica flour. The "flour" was prepared by grinding either a pure silica sand, *e.g.*, Ottawa, or a pure quartzite, *e.g.*, Wisconsin.

Silica flour in varying quantities up

to 1 or 2 per cent is sometimes also added to the ordinary molding sand in the pan mill. The casting probably skins more freely from the molding sand as a result of this procedure, and the refractoriness of the sand is obviously increased. The facing sand of cores is occasionally prepared with a much larger quantity of silica flour in the core sand, with the object of reducing "burning-on" as far as possible. It should be remembered that the silica flour is ground to a fineness which yields a certain amount of plasticity and bonding power. The admixture of china clay (kaolin) with molding sands was nowhere observed.

The quantity of old floor sand used in molding sand mixtures varies from nothing to 80 per cent. The latter quantity is higher than in the British practice, where 50 per cent may be taken as a maximum. The use of a greater quantity of old sand reduces costs appreciably, but it is probably related to the character of the sand. The artificial bond burns out, the burnt clay rubs away in part, and a small quantity only of fireclay is sufficient to "revive" it.

Use of Composition

The "compo" or composition of the British steel-founder, made from a mixture of broken crucibles, firebricks, sand, crushed quartzite, coke, graphite, etc., and used for large castings, is unknown in America. A similar product is, however, used in iron molding. Large steel castings are prepared in molds made from the same sands as small ones, but the composition is altered as required. Usually the bond is made somewhat stronger and silica flour is added to maintain the refractoriness. Castings weighing as much as [illegible] pounds are thus made.

[illegible] British practice small [illegible] not painted, and the sur[illegible] large ones are washed over with either "silica-paint" or a wash prepared by mixing compo with water and allowing the coarse material to settle. In the United States silica paint only is used, and most frequently molds of all sizes are painted. Painting is supposed to insure the production of a good skin upon the castings, and easy stripping from the sand. In the case of small castings, it is a matter of opinion whether paint assists the stripping by preventing burning-on of the sand, or is conducive to soundness in the casting. In America silica paint is generally prepared as a viscous fluid from silica flour and water with the addition of molasses, flour, glutrine and in some cases common salt. Silica flour alone is sometimes dusted over the mold.

The use of tar as a paint on large molds has almost died out in Britain, and was nowhere observed in America.

The nails used in sprigging the molds in American foundries are much larger than those employed in Britain. They are also used much more extensively. Sometimes the mold is studded with them. Apart from strengthening the structure, they also serve to conduct away the heat, but their excessive use seems to be undesirable and expensive. It may, however, be related to the weakness of the bond, as compared with that of European sands.

The venting of American sands does not appear, in most cases, to be so thoroughly accomplished as at home. In the case of the naturally bonded sands in the Eastern states, the grain of the sand grade in the natural mixture is smaller than that of Belgian and British sands. More need, therefore, exists for the opening up of New Jersey sand with coarse silica sands. In the few works where effective venting is secured, the improvement in soundness of the castings becomes evident.

The arguments adduced in favor of the practice of using artificially bonded silica sands are such that the writer is inclined to recommend the more extensive use of what might be termed synthetic steel molding sands. In order, however, to retain the excellent bond and stripping power of the sands, and the consequent good skin of the castings, it will be desirable to discover and use natural supplies of colloidal hydrated iron oxide (ochre) or compounds with similar physical characteristics. Here are problems for laboratory investigation and works experiments. Such an opportunity for standardization should not be ignored, but, on the other hand, the difficulties of the problem should not be underestimated.

More Standardization Desired

The introduction of repetition work into a foundry saves both time and labor, and increases production. It is evident that while it may not be feasible to standardize a number of foundries scattered over the country, using, perhaps, somewhat different materials, and faced by differing local labor conditions, yet there is room for a greater amount of standardization in each individual foundry. The introduction of far more molding and ramming machines into the foundry is a case in point. Molding sand practice leads itself to experimenting upon these lines, but there is a limit to the uniformity attainable, for it would be deplorable if anything were done to reduce the individualism of the trained foundryman—his skill, predilections, experience and traditions, and it is in this direction that the writer feels that the British foundryman is still ahead of his American brother. Prejudice must not be allowed to reduce this lead. The smaller individual output, not always due to more thorough work, threatens seriously [illegible] it. This is doubly [illegible] view of the fact that the most urgent question facing the foundry industry is the speeding up and increasing of production in every department.

In conclusion, the writer gladly takes this opportunity of recording his thanks to the numerous American gentlemen who gave him such a cordial reception and opened their works to him without reserve. It is to be hoped that American visitors to Britain will in the future be accorded at least the same facilities, and as hearty a welcome.

Move Head Office to New York

The Chicago Pneumatic Tool Co. plans moving its general offices from Chicago to New York and toward this end is erecting an office building at 6-8 East Forty-fourth street, New York City.

The structure, which is being built by the Westinghouse Church Kerr Co., New York, is of combination steel, brick, and limestone, and will comprise initially 10 stories, all to be occupied by the company.

The operation of the company's six American plants and 26 sales and service branches can be directed more economically from New York. There will be continued in Chicago a sales and service organization more extensive than formerly. The new building is to be ready for occupancy early in 1920, at which time the transfer will be effected.

The T. W. Price Engineering Co., Woolworth building, New York, is engaged in making plans for a large foundry for making cast iron pipe, by the new process known as the "centrifugal cast iron pipe process," which has proved successful in an installation at the plant of the National Iron Works, Toronto, Can.

A soldering paste for use in soldering aluminium, patented by H. C. Proctor, consists of powdered rosin, 75 per cent; vaseline 20 per cent and ammonia, 5 per cent.

Molds Made by Centrifugal Method

In Order to Attain Maximum Efficiency it is Necessary That Molds be of Sufficiently Heavy Section That Repeated Use Will Not Bring Them to Red Heat

By J. E. HURST

AS a result of the desire to avoid the destruction of the mold after the completion of each casting, permanent molds of various types are employed.

The system of pressure die casting is not being applied commercially to ferrous castings, and the author is not aware of any extensive experiments in this connection. The production of castings in cast iron by the centrifugal process, however, might be classified under the heading of pressure die-casting.

It is the author's experience that the occurrence of pinholes in cast iron die castings made in stationary dies is entirely a question of the temperature of both the metal and the die, and is not influenced by the cast-iron die unless, of course, this is in a very badly disintegrated state.

In certain circumstances cast-iron dies have been known to crack after being in use for a very short time. In these cases the cracking can for the most part be traced to defective design of the dies, and also to the presence of internal defects such as blowholes and porosity in the die material. Defective design resulting in the production of uneven internal stresses is more frequently met with in dies of complicated design. Apart from such cases the failure of dies takes place by a peculiar form of surface cracking and disintegration, which ultimately results in the complete fracture of the die.

The rapidity of the initial formation of surface cracking in dies depends entirely on the maximum temperature attained by the die in use. Growth commences at temperatures of from 650 degrees to 700 degrees Cent., or at quite a red heat. If the dies are allowed to attain this temperature the surface growth will rapidly take place. It is necessary, therefore, to have the dies sufficiently thick in order to prevent this temperature being regularly obtained under the particular conditions and rate of casting in vogue.

Messrs. Rix and Whittaker, as a result of their experience with aluminum-bronze die-castings, in which the die temperatures attained are quite comparable with those of cast iron, state that the life of dies in their practice was approximately 5000 castings.

Distortion troubles also can frequently be attributed to defective design of the die, resulting in the heat producing internal stresses, setting up the strains which ultimately result in the permanent distortion, and frequently cracking of the dies as noted.

Apart from the effort of bad design, permanent distortion in the mold appears to be due to the gradual decomposition of the combined carbon. The internal stresses set up as a result of the volume changes result in the gradual permanent distortion of the mold.

The best method, in the author's experience, of reducing these troubles to a minimum is the use of an iron with an extremely low combined carbon content.

In the production of the die blocks of cast iron, closeness of grain is quite an essential feature, as this tends to minimize the rapidity of surface growth. The production of very low combined carbon material, at the same time accompanied by a very close grain, is frequently a difficult matter, particularly in thick dies cast in sand. The use of chilled molds is therefore advisable for the production of cast-iron die-blocks of low combined carbon.

The temperature to which the die is subjected appears to have little ultimate influence on the distortion as whatever the temperature the combined carbon content is ultimately decomposed, particularly if the silicon is in excess of 1.5 per cent.

Iron castings made by the centrifugal method of casting might be considered as belonging to the die-castings class. For many reasons, however, it is preferable to consider such castings as belonging to a separate class, and the author prefers the distinguishing title of centrifugal castings.

In the centrifugal process, castings are produced by introducing the molten metal into a metal die, or permanent mold, which is rotated at a high speed. The molten metal takes the required form of the mold as a result of the centrifugal action due to the high speed of rotation.

Most castings having a cylindrical internal form can be produced by this process. The external form need not necessarily be strictly cylindrical, and castings having considerable variations in the shape of lugs, projections, and fins on the external face can be produced by this process.

Some of the advantages of the centrifugal process over ordinary die and sand castings are said to include: Absence of gates, runners, risers and feeder heads; the entire absence of cores; the ease and rapidity of production; the absence of necessity for cleaning.

Die-cast iron castings possess distinct advantages over ordinary sand castings, in the author's opinion. The foremost advantage is undoubtedly the extremely fine grain size.

The grain size of any fine composition cast iron is, generally speaking, a function of the rate of cooling. The more rapid the rate of cooling the smaller the grain size. By the use of metal dies the rate of cooling of the cast iron is considerably increased, with a resulting increase in the fineness of the grain. The obvious danger is the possibility of the rate of cooling being sufficiently fast for chilling to take place, g[illegible] the castings a hard unmachi[illegible]te-iron skin. This, howev[illegible] be avoided by a suitable ad[illegible]s of the composition of the iron, the thickness of the mold, and the temperature of the metal and mold before pouring.

The foundry, as an occupation for a large majority of our brainy youths, is very frequently passed over as being a "filthy job." This is due largely to the employment of sand as a molding material. From an aesthetic standpoint alone, therefore, the more extended use of permanent molds or dies is warranted, and it seems certain that this would assist in the future development of the craft.

The Lumen Bearing Co., Buffalo, expects soon to build a plant at Youngstown, O., where mill bearings and other heavy brass castings will be made to supply increasing demand.

Abstract of paper presented at the July, 1919, annual conference, British Foundrymen's association, Liverpool, England.

Castings for Ship Construction—IX

Suggestions For a Different Design in a Standard Propeller-Bracket Pattern Are Offered, and Full Details Concerning the Building up of Barrel, Arms and Palms are Presented

By BEN SHAW and JAMES EDGAR

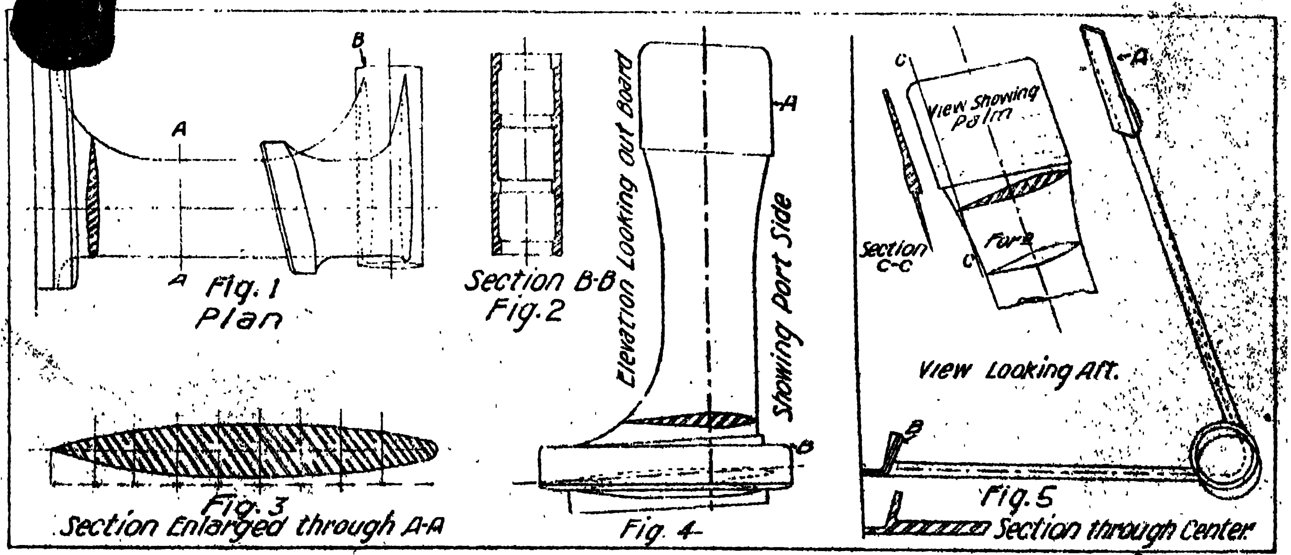
ALTHOUGH the design of the propeller bracket shown in Figs. 1 to 5, resembles in some respects the one described in the previous article, it differs in some important details. The section of the arms or fishbacks is the same in both cases, except that in the bracket under consideration they are not cored out, but are cast solid. These brackets sometimes are called A-frames, because of their shape. It will be observed that the boss in this case is long, and the palms are, of course, quite different. It might be possible to make the pattern for this bracket in a similar way to the one already described, that is, by building two mocks on the floor, fitting the arms between them and the boss, after the palms are finished. But this would be a clumsy task. It would be difficult to secure accuracy, or to get a job sufficiently strong to withstand the wear and tear in the foundry.

It is possible to build this bracket in a position corresponding to that which it will take in the ship. The construction of the pattern requires great care, because of the angles of the arms in relation to the boss, and the angles of the palms in relation to the arms. It would be inadvisable, even with the most careful workmen, to allow a bracket pattern to go to the foundry without a careful examination. An idea of the difficulty of making the bracket pattern is obtained when it is pointed out that the barrel for the boss is sometimes 25 feet long.

Sketches of the templates supplied by the molding loft are not given, because they are similar to those for the propeller bracket described in the previous article. A template is made for the arm section. In this case the arm does not taper in thickness toward the palm, but is of uniform section throughout. The angle of the boss is given by a template. This rectifies any discrepancy between the drawing and ship. A template also is necessary for both shape and angles of the palms, while a large template defines the angles of the arms to each other. It is not necessary to set the job out in full on the floor. The better way is to make full size views of each arm on a drawing board, and either set out center lines of arms and boss on a drawing board or on the floor. It is necessary in order to economize when getting out lumber, to make scrap views of fillets, palms and parts of the barrel. As only the best lumber can be used on such work the importance of economizing is great.

The boss for this bracket is long so it is necessary to provide two lifting bolts and the stays (A, Fig. 6) should be made about three inches thick, and four or five inches wide. The lumber should be placed perfectly straight, for if it is warped in the length it will be impossible to make a true barrel. It is good practice to get out all the timber for such a job at the beginning, cutting it to approximately correct widths and thicknesses. Even a comparatively straight grained board will change its shape when reduced in thickness or cut into widths. But if cut to the correct thicknesses and widths, and allowed to lie for a day before being planed it will be less subject to distortion. In some patternshops this is the charge hand's work, after he has set down the job, and apart from the saving in lumber it compels him to master the details of the job thoroughly at the beginning. It is not possible, however, to adopt this practice with some jobs, where every piece of lumber has to be cut separately and fitted. The rings or grounds should not be more than 20 inches apart. As the lifting bolts—usually 1¼-inch bolts—will drop down toward the outside of the barrel, special stays like *B*, Fig. 6, should be checked into the rings. These form guides for the bolts.

It is not well when making such a heavy barrel to rely on the stays



FIGS. 1, 2 AND 3—PLAN AND SECTIONS OF TYPE OF PATTERN FOR A PROPELLER BRACKET FIG. 4—ELEVATION OF PATTERN FOR PROPELLER BRACKET, LOOKING OUTBOARD FIG. 5—VIEW LOOKING AFT, WITH DETAIL OF PALM

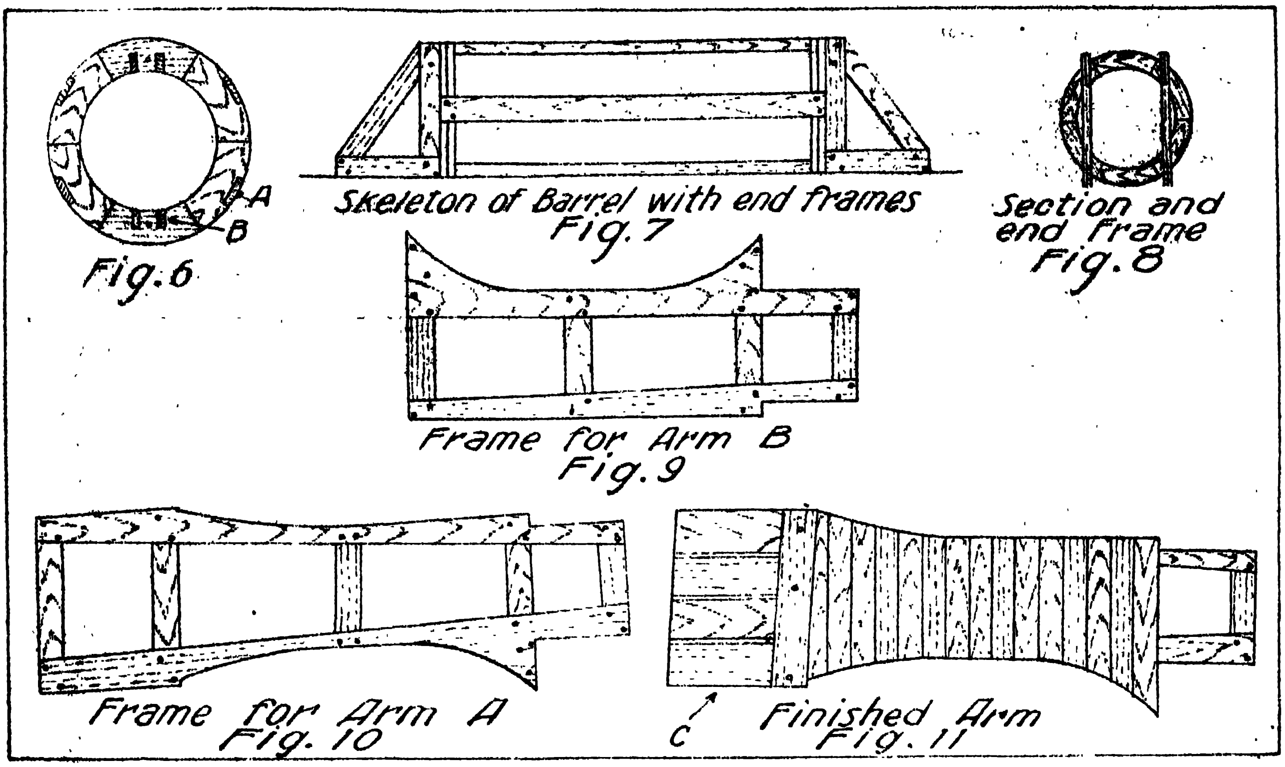
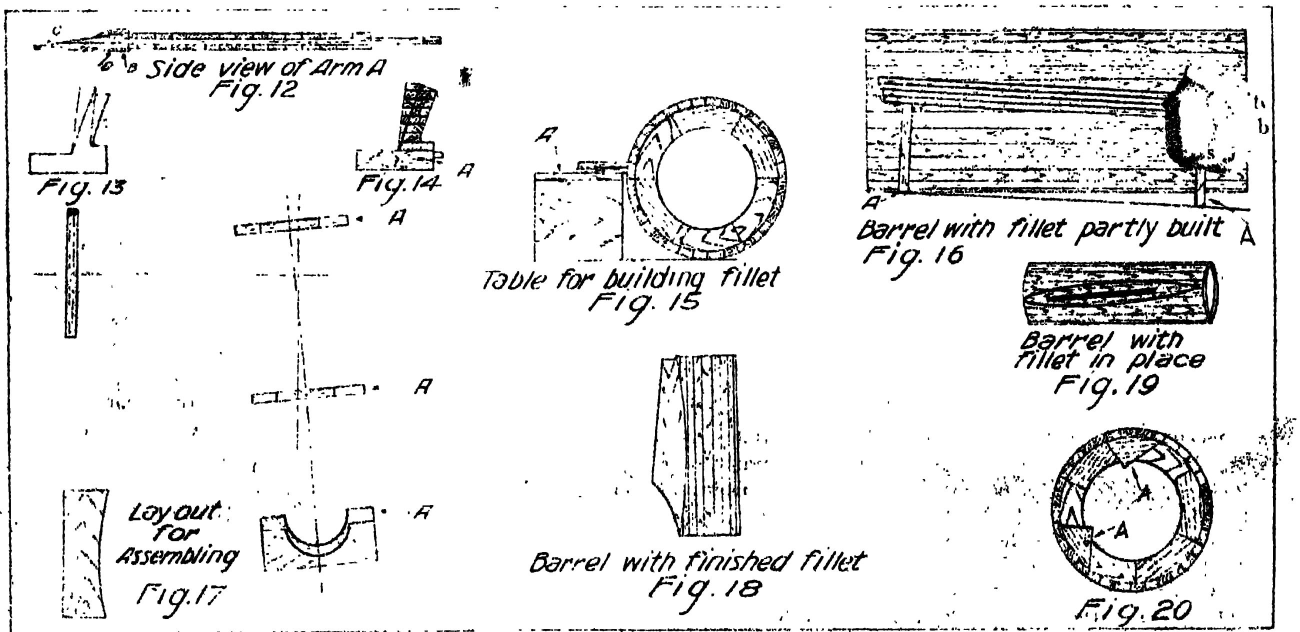


FIG 6—BOSS FOR PROPELLER BRACKET PATTERN, SHOWING THE LIFTING BOLTS FIG. 7—SKELETON OF BARREL WITH END FRAMES FIG 8 END VIEW OF SKELETON BARREL SHOWING END FRAMES FIG. 9—FRAME FOR ARM B FIG 10 FRAME FOR ARM A FIG. 11—FINISHED ARM

while fastening the lagging. Cross center-lines should be drawn on the rings, and the skeleton fixed on the floor with end triangular frames, Figs. 7 and 8. It is a simple matter to screw straight edges across the center lines on each end, on which to try a level. It is necessary, of course, to pack one end ring underneath, as each ring is of a different diameter owing to the taper of the barrel. A few diagonal stays usually are fitted inside the skeleton between the rings before the lagging, which ought to be 1½ inch or 2 inches thick, is screwed on. The lagging for such a job should be open jointed. When half of the barrel has been covered with the lagging, the triangular frames can be safely removed and the remainder of the lagging fixed. The frames for the arms, Figs. 9 and 10, differ from each other because the palm *A* in Figs. 1, 4 and 5, is built on the center frame, while the palm *B* is made separately and dowelled on. The fillets would be too un-



FIGS. 12, 13 AND 14 SIDE AND SECTIONAL VIEWS OF ARM SHOWING THE JOINT OF THE PALM FIGS. 15 AND 16—TABLE FOR BUILDING FILLET AGAINST THE BARREL FIG 17—ARRANGEMENT FOR ASSEMBLING THE VARIOUS PARTS OF THE PATTERN FIG. 18—BARREL WITH FINISHED FILLET FIG. 19 BARREL WITH FILLET JOINED IN PLACE FIG. 20—ARRANGEMENT OF BLOCKS INSIDE THE BARREL FORMING SQUARE FACES FOR NUTS

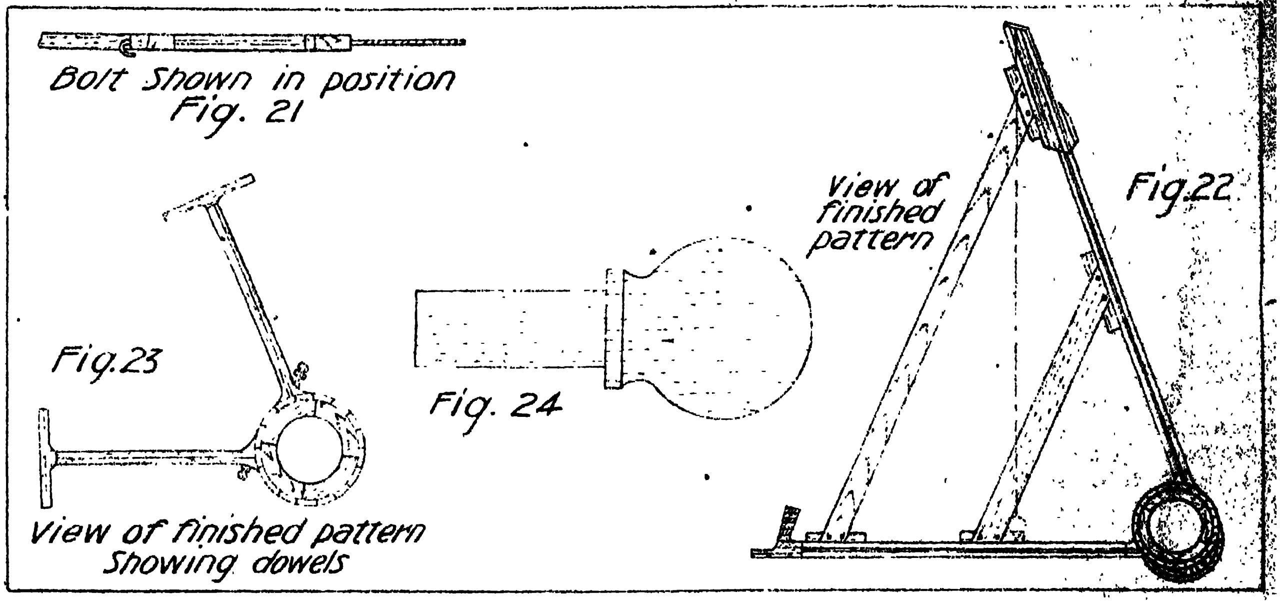


FIG. 21—HOOK BOLT SET IN POSITION FIG. 22—PROPELLER BRACKET PATTERN COMPLETED AND ASSEMBLED FIG. 23—COMPLETED PATTERN SHOWING THE USE OF DOWELS FIG. 24—DETAIL OF SUITABLE FORM OF DOWEL

wieldy if completed separately from the arms. A better way is to form part of the fillet on the arm. The arms should be fixed by hook bolts, the hooks gripping the frame of the arms, and the bolt penetrating to the inside of the barrel. Of course a guide has to be formed for the arm, and this is done by making the frame act as a dowel into a recess in the fillet. The center frames should be stoutly made. The portion at the boss end forming the dowel should be the depth of the part of the fillet which is fastened on the boss. This should be a foot or more, depending on the length of the arm.

The best way to build the arms is to screw pieces across the frame. [illegible]ces are straight, and can be [illegible]nd sand-papered to shape from a template. The fillet portions can be sawed roughly and finished off after the whole arm is built. Although in the sketch, Fig. 10, the arm *A* is shown the full length, the actual length is determined by the edge view. Thus in Fig. 12, it will be seen that the bevel on the back of the palm requires the frame to be made short. It is long enough, however, to support the thicker pieces *C* which have to be screwed on the face and left open-jointed. A portion of the face *B*, shown in Fig. 12, has to be left loose with a long taper at *D*, the purpose of which will be explained when the molding is described. To complete the arms *B* the flange or palm has to be finished and dowelled on. If a view like Fig. 13 is drawn, showing the shape on both ends of the palm and cross lines 1 inch apart are set down on it, 1-inch lumber can be used for constructing it, and each thickness finished, before it is fastened on. This is both a quicker and more accurate method than building lumber roughly and shaping it finally. The face *A*, Fig. 14, which joins the arm, has to be planed so that the angle of the palm will be correct. Care must be taken also when inserting the dowels. If centers are drawn on each face, there should be no difficulty. It is necessary to trim the edges when the palm is dowelled on. This will have to be screwed as well as dowelled to keep it rigidly in position while the molder is ramming sand around it.

Building the fillet is the most arduous task of all. It has to be built in position on the barrel, and the finishing has to be done after it is built. The jointing of the lumber depends greatly upon the size, and the shape of the fillet, and no hard and fast rule can be applied to all cases. It is wise, of course, to feather-edge such fillets, where they join the barrel with the end of the grain. It must be remembered the fillets are not glued on, but have to be left loose, that is with screws inserted which can be withdrawn, allowing the barrel to lift from the sand. Screws may be put in from the outside temporarily, but after the fillets are built, and before they are cut, it is more convenient to screw them from the inside of the barrel. This is easy, as the barrel is large enough in diameter to permit a boy or man on the inside to use a screw driver. Each fillet will be considered separately. When the longitudinal center line of the barrel is set down on the floor, and a line corresponding to the face of the fillet is also drawn with the center line of the arm bisecting it, the barrel will have to be lifted on saddle pieces, so that the fillet can be built with a level center. This is necessary because the cross centers of the arms are not on the same plane as the horizontal center of the boss. Fig. 17, which shows the arrangement for finally assembling the various parts will give the arrangement for building the fillet. The saddle pieces are first screwed down, and the barrel rested on them and retained in position by screws or battens on the ends. A table, *A* Figs. 15 and 16, has to be made for building the top part of the fillet, and the first piece of lumber will correspond with the line of the top face of the arm frame. This will assure the recess for the dowel being correct.

A rough outline of the elliptical shape formed by the junction of the fillet with the barrel should be drawn on the latter. This is not a difficult matter as width and length are given on the working drawing, and as it has already been said the shape between is largely a matter for the craftsman's judgment. The line for the face of the fillet should be squared from the floor to the top of the stave. In building the layers of lumber for the fillets glue should be used, as not many screws can be left in while shaping.

When the top of the filler is built the table is removed. Two pieces, exactly the same thickness as the arm should form the next layer, and the space between them will correspond with the width of the arm dowel. The bottom then can be built in a manner similar to the top. Some short laths of very straight grained pine and about ¼-inch square are a great help in shaping the fillets. This is better than to rely entirely on sight and touch, as both hand and eye fail to detect slight flats and lumps, after the craftsman has been working at the job for some time. Wherever the lath is tried on the fillet it should bed along its entire length. Sometimes these large fillets are built in four or more sections for convenience in handling, both in the patternshop and in the foundry, as the fillet must be drawn into the barrel space in the mold. This advantage, however, is balanced by the extra trouble in jointing and screwing the sections together after each cast. Jointing also destroys the reliability of the fillet as a guide for the arms. When the barrel is long the fillet extends from end to end, and it might be wise in such a case to make the fillet so that the top above the dowel can be drawn into the barrel separately from the bottom. When a fillet is made the barrel should be turned around and the other fillet built in a similar way. In this case new saddle pieces have to be made, and probably a new table, as the angles will be different. The careful workman will put on all the necessary center lines for both fillets, and make the tables and saddle pieces, before he begins the construction of the fillets. A slight error in these fillets will produce a big error in the length of the arms. Two views of the barrel with a finished fillet are given in Figs. 18 and 19.

It would be impossible to bolt the arms to the barrel unless provision is made for the nuts inside the barrel. Blocks *A*, Fig. 20, should be built and screwed inside to form a square face for the nuts. When the bolt holes have been bored the whole pattern is ready for assembly. The saddle pieces which were used for making the fillets are used again. The barrel should be set as it was when making a fillet. This means that in the length the arm will be level. A saddle piece should be made for the arm to rest in. The arrangement of these saddle pieces on the floor is shown in Fig. 17. The hook-bolts, two for an arm, are fixed as in Fig. 21, and when the arm is pushed into its position the nuts can be screwed on the inside of the barrel. In addition to the bolts it is as well to put in some temporary screws on the outside. The arm may be removed and the barrel set to receive the other arm. It is advisable to bolt both arms in their positions resting on the floor. When the second arm has been fixed it is not necessary to remove it. The other arm is hoisted into position with a block and tackle or a crane, but as it has been in position it is not difficult to replace. The completed pattern is shown in Fig. 22. It is probable that the top arm will droop a little, unsupported. Stays are fitted between the arms to prevent this. It would be awkward to make and fit a half-lapped frame between the arms. The stays which are shown in the sketch should be dowelled and also screwed to blocks fixed on the arms. Before the holes are bored, however, the arms should be tested for position.

The distance between the tips of the arms on the centers can be obtained from the floor, and the work tested with a steel tape. The best test, however, and the only one which probably will satisfy an inspector, is to drop a plumb line from the center of the top palm to the floor, or the top of the other arm as the case may be, the center having previously been marked. If reasonable skill has been expended in making and marking off the various parts, there will be no inaccuracy.

If the work is large it is much better to disassemble it and convey it to the foundry in parts, where it can be put together easily and quickly. The screws which must be drawn by the molder to get the fillet and the arms withdrawn from the mold, have to be painted round, so that none will be unnoticed and left in. Molders do not always remember to try if they can get every piece free, before bedding a pattern in the sand, although they should do so, and as with other steel castings, if square corners are wanted anywhere because of the plating, the fact should be written distinctly on the pattern.

For small brackets of this type, or even of the type described in the previous article, the arms may be constructed and fixed to the boss in another way. Where the arms are only 3 or 4 feet long it would be manifestly absurd to so build them. They may be bolted to the barrel, and it might not be possible to dovetail them. The usual practice and probably the best is to make a solid arm of two or three thicknesses of timber and screw extra thicknesses at the ends for fillets. When this is done the whole can be shaped at one operation, and fitted to the barrel. Screws will hold it quite rigid, but it will be a great convenience for the molder if dowel pins are put through the fillet into the barrel. These dowels should be 1½ inches or 2 inches in diameter, and with a good handle so that they can be withdrawn easily. A suitable form of dowel is shown in Fig. 24, and such a pattern shown finished in Fig. 23. It is often possible with these smaller brackets to screw the palms to the ends of the arms, either leaving the molder to arrange for the fillet, or making the fillet separately against the arm and palm so that it can be drawn in. If the foundry is near at hand and the patternmaker can be in attendance, or can be consulted by the molder, some details can be left, although it is wiser, within practical limits, to leave as little to the foundry as possible. After all, the patternmaker is working to a drawing, and it is not quite fair to the molder to expect him to know what is wanted, when he has not the opportunity to study the drawing.

There is no difficulty with the shaft core for the bracket, a plain board being all that is necessary.

Types of Foundry Buildings Described

The Austin Co., industrial engineers and builders, has just issued a new booklet known as catalog No. G. It contains cross-sections of the company's ten standard types of buildings and gives a description of Austin service to foundry and steel plant owners.

The object of this booklet is to condense the description of the Austin company's complete building service to a booklet that can be read [illegible] four or five minutes and that wi[illegible]e pocket conveniently.

New Core Binders.

A new form of dry core binder has been developed by Corebind, Ltd., 5 Castle street, Finsbury, London, E. C. 2, England, and arrangements are being considered for marketing this product in the United States. Since the powder is furnished in dry form, it can easily be mixed with the sand in correct proportions even if the sand is already moist. The proportions of binder necessary vary from 1 to 20 to 1 to 40, according to the nature of the sand used.

A recently patented mixture for making molds for casting light metal articles is made of plaster of paris, 40 parts; asbestos fibre, 30 parts and brick dust, 30 parts.

Bethlehem's Ingot Mold Foundry

Direct Metal From Blast Furnaces as Well as Cupola Metal is Used—Arrangement For Storing and Charging Coke is Unique—Molds Are Poured From a Long Platform

By E. C. KREUTZBERG

PRIOR to the tremendous expansion in the steel production facilities of the Bethlehem Steel Co. during the past few years, all of the ingot-mold requirements of the company were taken care of by the iron foundry at the Lehigh plant. This foundry had sufficient capacity to produce 4000 to 4500 tons of ingot molds per month. After the Bethlehem Steel Co. took over the properties of the Maryland Steel Co., the Pennsylvania Steel Co. and the American Iron & Steel Mfg. Co.. the capacity of the foundry at the Lehigh plant became wholly insufficient, and it became necessary to purchase a large portion of the ingot molds required for the operation of the various works.

In order to meet the needs resulting from this expansion, the erection of a new ingot-mold foundry was undertaken at Bethlehem. This plant, which only recently was completed, is an unusual establishment. Its capacity is 10,000 tons of ingot molds, stools and bottom plates per month. This output not only is large enough to supply the full requirements of the Bethlehem Steel Co. plants at Bethlehem, Sparrows Point, Lebanon and Steelton, but 30 to 35 per cent of the total capacity will be available to other eastern steelmakers. The new ingot mold foundry contains about 85,400 square feet of floor space, has a maximum length of 550 feet and a maximum width of 272 feet. Of this area, a 75 x 275-foot space is given over to the raw material yard which, unlike the stock department in most foundries, is completely covered by a roof. Of an unusually substantial character, the foundry building has a steel frame, brick walls, a poured gypsum roof and other details which make it thoroughly fireproof.

Mixer Metal Used

Due to the general plant layout at Bethlehem, the ingot mold foundry is arranged for handling both hot metal and pig iron. Hot metal is obtained from blast furnaces which supply all other departments of the plant; hence a supply of hot metal cannot at all times be obtained at the moment it is required. For this reason arangements were made for melting pig iron when hot metal cannot be obtained. Two cupolas, each with a capacity of 40,000 pounds per hour, and one 450-ton mixer comprise the equipment for providing metal at this foundry. Of the raw material for the cupolas, 90 per cent is bessemer pig iron made by the Bethlehem Steel Co. in its own blast furnaces. The remaining 10 per cent comprises scrap originating in the various departments of the company. The mixer, shown in an accompanying illustration, is of standard construction. It is equipped for burning oil or by-product coke oven gas, and hot metal may be maintained in it at a satisfactory temperature for any desired length of time.

The arrangement for handling the charges for the cupolas and for facilitating their operation generally is of considerable interest. For serving the cupolas, there are two platforms, one at the level of the spout and the other at the charging level. Pig iron and scrap are loaded into flat boxes, which are brought to the charging platform

FIG. 1—MOLDING FLOOR AND PIT SHOWING EQUIPMENT FOR PRODUCING INGOT MOLDS AT THE NEW FOUNDRY OF THE BETHLEHEM STEEL CO.

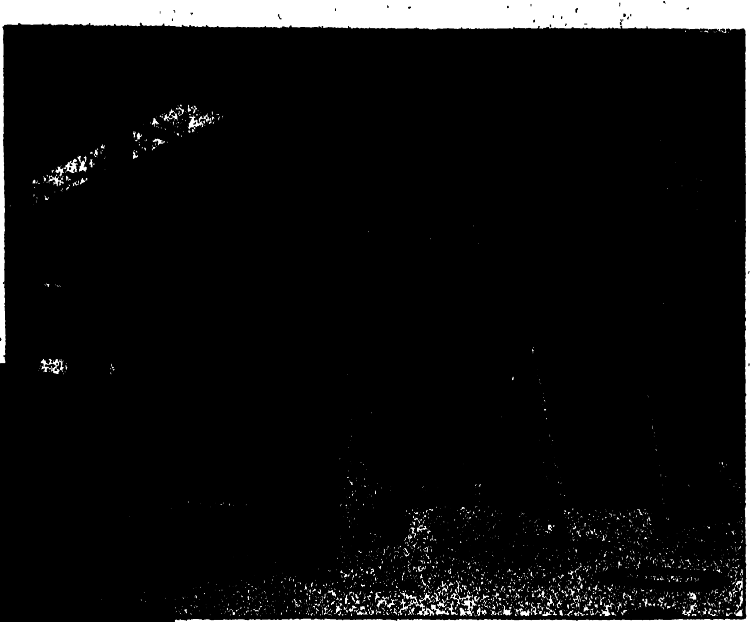


Fig. 2—Coke is Elevated to Bins Above the Charging Floor From Which Measuring Buckets Are Filled for Charging the Cupola, in Order to Save Labor in Handling.

Fig. 3—The Cupolas are Elevated so That the Bottoms May be Dropped Directly Into Cars Instead of on the Floor, Thus Saving Expensive Handling.

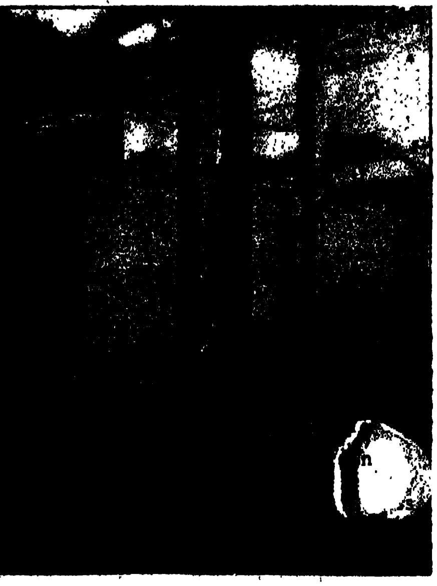


Fig. 4—The Foundry is Equipped With a 450-Ton Mixer Which is Charged With Molten Metal From the Blast Furnaces.

Fig. 5—The Molds Are Dried in Double-Ended Ovens From Which They Emerge Onto the Pouring Floor, Where They Are Placed Alongside the Pouring Platform.

by means of two 25-ton cranes which span the raw material yard. On the charging floor they are placed on buggies which are pushed in front of the charging doors where the pig iron and scrap are charged by hand to insure proper distribution of fuel and metal. All iron is charged by weight; fuel, however, is charged by volume.

How Coke is Handled

The iron is charged through doors at the front of the cupolas and the fuel through doors at the rear. Fuel is delivered to the foundry in cars which are spotted over track hoppers and from the bottoms of the hoppers the coke is conveyed by a skip hoist to bins above the charging floor. These bins are three in number and each has a capacity of 30 tons. From the bins the fuel passes into fixed-volume buckets, the flow being controlled by means of gates at the bottoms of the bins. In order to facilitate the removal of refuse from the cupolas, the latter were built at an elevation so as to afford ample clearance for cars which are spotted beneath them at the conclusion of each heat. Into these cars, which operate on rails, the bottom is dropped and the cars then are pushed to a dump where their contents are discharged. This system greatly decreases the amount of work necessary around the cupolas and accordingly cuts down the cost of operation. In order to have a clear space beneath the cupolas, the bottom doors are kept in place by pneumatic plungers, which are released at the time of dropping.

On the molding floor, specially designed 3-part flasks are used. The flasks are cast iron. Unlike the practice at many plants where the spindle is molded separately and set on the bottom plate, the Bethlehem Steel Co. molds the [illegible] and spindle as a unit. In th[illegible]ion, the spindle is set in p[illegible] keyed to the cast-iron plate, after which the sand bottom is rammed. Next, the pattern is set in place over the spindle, being maintained rigidly in position by the use of an arbor which fits inside the top of the pattern and centers it about the spindle. The flask then is lowered onto the bottom, after which sand is filled in between the spindle and the pattern, and between the pattern and the flask, both being rammed together. The flask is then lifted and the pattern drawn. The ramming of the molds is done in pits, and the molding of the bottom and spindle in one piece results in a smooth casting since this method prevents the formaton of fins which result when the spindle is not integral with the bottom.

From the molding pit the molds are transferred by cranes to the drying ovens. There are eight of these ovens, each 12 x 25 feet. They are of the car type and are fired with by-product coke oven gas. The entrance to these ovens is on the molding side and the exit, from which the dried molds are discharged, is on the pouring side of the shop. On being withdrawn from the ovens, the molds are assembled alongside a raised concrete pouring platform 7 feet wide and 175 feet long. Each mold, when rammed, is provided with a sprue reaching from the top down to the bottom in order that the casting may be poured from the bottom. In order to pour without causing injury to the mold, through spattering of the metal, the sprue is surmounted by a large sand box.

The use of the concrete pouring platform supercedes the old method of pouring in pits. It has been found that the platform makes it possible to assemble, finish and pour the molds with greater facility and a greater degree of safety than is possible with the pit pouring method.

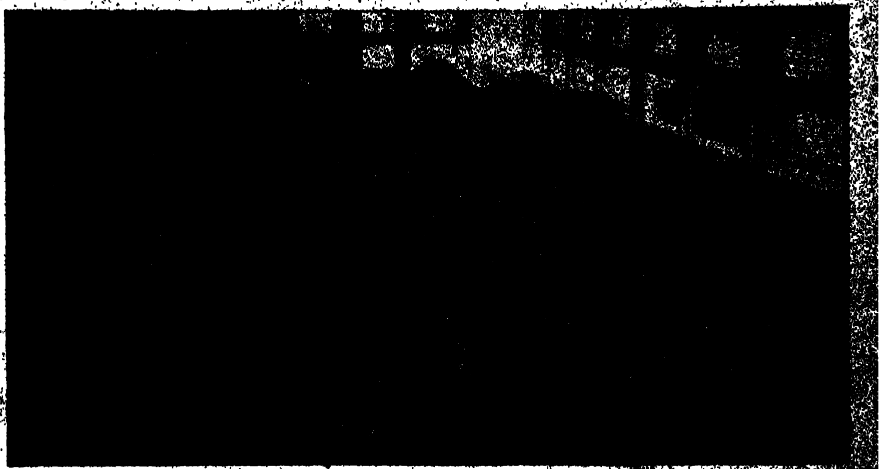


FIG. 5—THE STOCKYARD IS ENTIRELY PROTECTED FROM WEATHER AND IS [illegible] BY CRANES WHICH LIFT THE CHARGE FROM THE CUPOLA [illegible]

General Equipment

In addition to the cranes in the raw material storage yard, the casting and cleaning section of the foundry is provided with one 40-ton and three 25-ton cranes. The mixer department is provided with a 100-ton ladle crane and the molding shop with three 25-ton cranes. The foundry is provided with a sand mixing screen and with a pneumatic system for conveying molding sand to the various floors. A 30 ton jar-ramming machine has just been installed for ramming the molds.

The foundry is provided with a full equipment of flasks large enough to produce molds for ingots ranging all the way from 6 x 6 inches up to 22 x 80 inches. Ingots of the latter size weigh 34,000 pounds each. The foundry equipment includes a wet pan for mixing material for luting the cupolas and also for mixing foundry facing.

The foundry is provided with the necessary equipment for finishing cast-iron flasks, including a planer, a radial drill and other machinery. Scales are at hand for weighing the individual molds as well as for weighing carload shipments of molds and of raw materials.

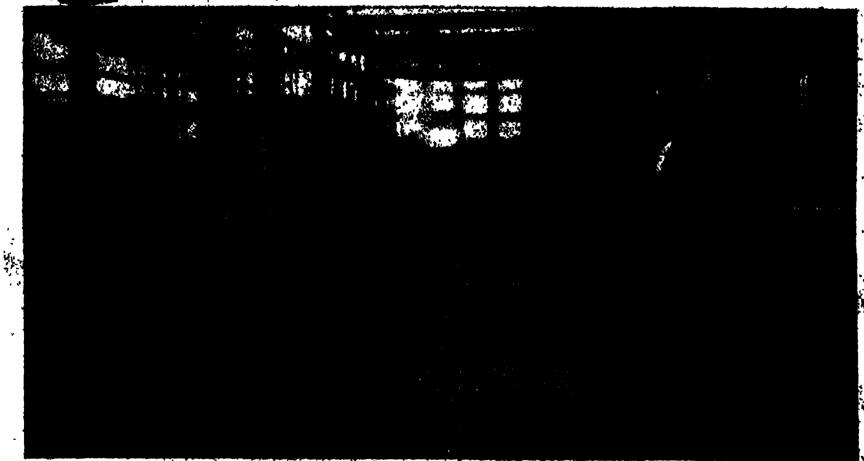
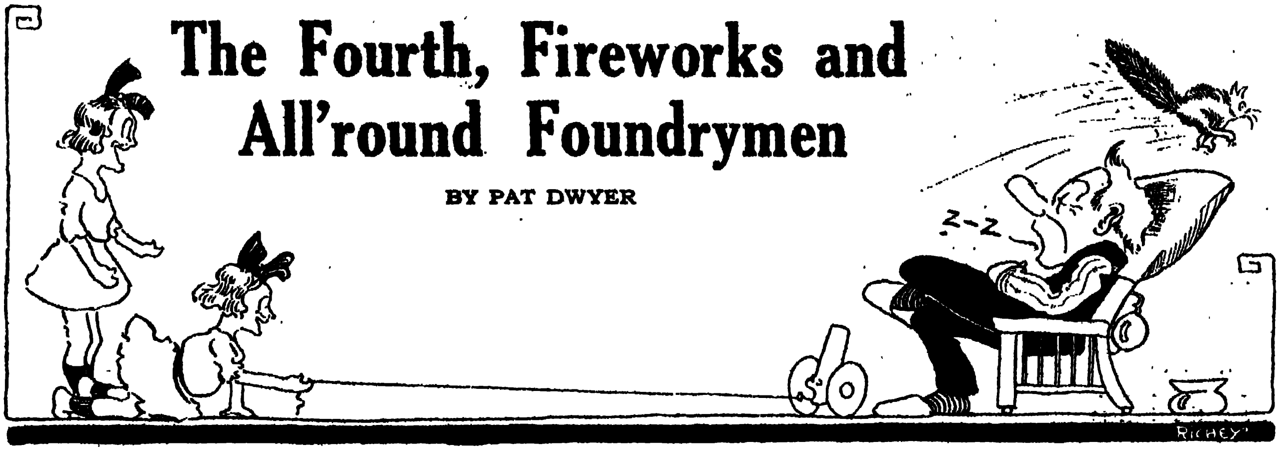


FIG. 6—AFTER COMING FROM THE DRYING OVENS, THE MOLDS ARE SET UP ALONGSIDE A 175-FOOT CONCRETE PLATFORM ON WHICH THE OPERATOR STANDS WHEN POURING



The Fourth, Fireworks and All'round Foundrymen

BY PAT DWYER

ON THE evening of July 4, which is also known and referred to in these United States and outlying island possessions as Independence Day, I went for a stroll in the park with the ultimate object of viewing the fireworks. Not verbal fireworks, but the real old simon pure article, rockets, pin wheels, nigger chasers and roman candles. The younger members of the family had brought home glowing accounts during the day of the progress of the work. Every step in the process of setting up the frames and scaffolds for the set pieces was carefully noted and reported upon. The evening meal was hurried through and we were on the way.

I was accompanied on this excursion by two charming young ladies who made up in volubility what they lacked in stature. I have been paying these young ladies' room and board bill for several years. I even buy clothes for them occasionally and if the shoes I bought for them were placed end to end they would reach from Fire Island light to the Golden Gate.

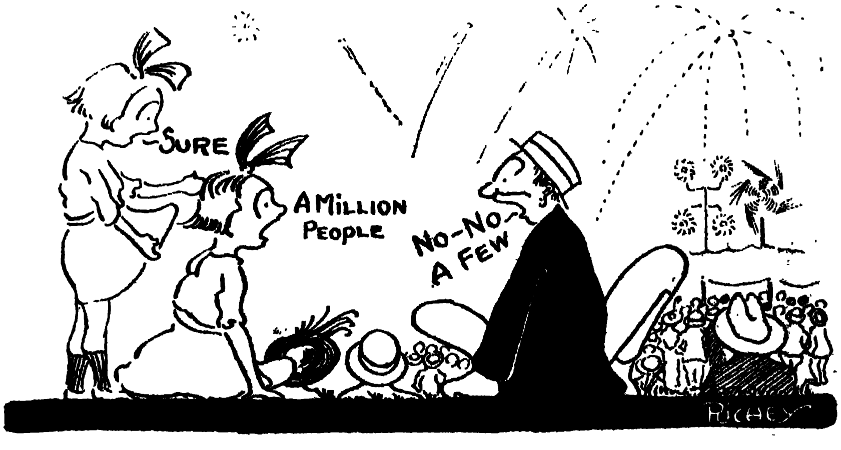
They arrived at our modest home within a few years of each other, without credentials of any kind. In fact they brought nothing, not even the clothes on their backs. My lady wife, who is a suspicious nature where strangers are concerned, waived all ceremony on their account and welcomed them quite effusively. I thought, at the time, that she was rather over enthusiastic considering that their appearance was a trifle unprepossessing—if you know what I mean. In the course of time I have come to share her enthusiasm and now I am as willing to uphold their claims to feminine pulchritude as any knight of the olden time who laid a spear in rest to prove the superior charms of his lady love. From occasional remarks which I have heard these ladies make, especially on paydays, I am led to believe that the feeling is reciprocal. All of which of course is very interesting to me, but what do *you* care? Nothing.

We went down to the park and after strolling around for a while we found a nice grassy spot and sat down. The crowd began to gather and one of the young ladies ventured the opinion that there were about a million people present. I was doubtful. I told her I was not in a position to give her the exact figures but I was quite positive it was not a million. "Well, then," said she, "half a million?" Judging from my expression that I did not agree with her she compromised by saying, "It is the biggest crowd *I* ever saw." I told her she was perfectly right, that was just about the exact size of the crowd.

There was music by the band, speeches by prominent citizens, and community singing. In a booth nearby a gentleman and his wife lately from some place in central Europe, dispensed ice cream and carbonated beverages. Needless to say the drinks were not sold under a good old sterling Anglo-Saxon title. The same process of evolution that is gradually wiping out the predominance of any one race or nationality in this country is also playing hob with our language. How else do you account for the fact that drinks which were known a few years ago and still are referred to in Boston as carbonated beverages are known in Buffalo, Erie, Cleveland and all points West as "pop"? The attention of the secret service department should be directed to this, the word "pop" has a teutonic sound.

Just before it became dark I saw a hat waving above the crowd, The old dip looked familiar and my opinion was verified a few minutes later when I made out Bill's long nose and bandy legs. We celebrated his arrival with another roun[illegible] the "ice cold" which Bill re[illegible]nsisted upon paying for.

The mayor thanked the [illegible] one and all, for the attention to his few remarks, he hoped he would have the pleasure of addressing them again on the next Fourth of July (great cheering) then announced that the band would play "The Star Spangled Banner," to which he hoped all would lend their voices, after which the pyrotechnic display would take place. Immediately after proclaiming to all the world that this

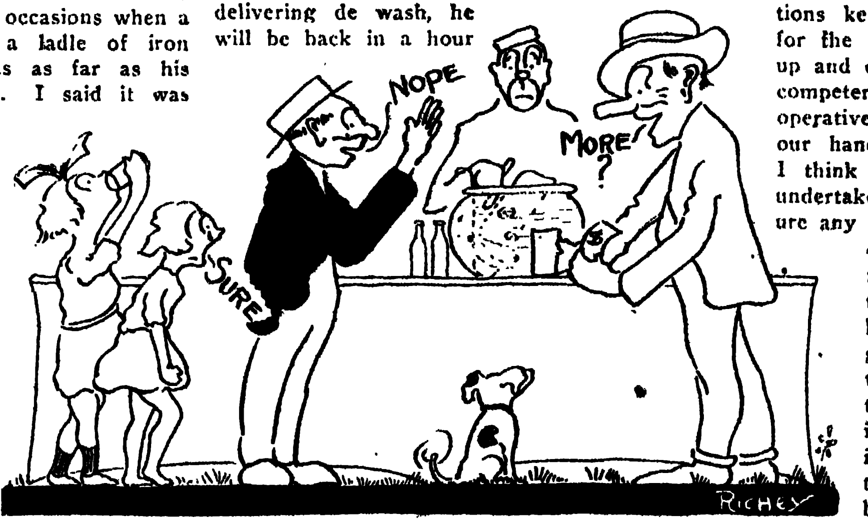


THE CROWD BEGAN TO GATHER

was the land of the free and the home of the brave, the crowd wildly stampeded for the section of the field which had been roped off. I was quite satisfied to stay where we were but the young ladies insisted on getting down to the firing line. I had received strict orders before leaving home to be "careful of those children and keep out of the crowd" but I decided to take a chance and if anything happened I could blame it on Bill.

He went ahead and by the judicious use of his elbows and yelling of "gangway" every few steps we finally found ourselves up against the ropes. Soon the show was on in full swing and a chorus of "Ohs" and "Ahs" greeted every rocket.

I asked Bill if he had any idea how fire works were made. He said he had seen some fireworks in the foundry on different occasions when a mold blew up or a ladle of iron upset, but that was as far as his knowledge extended. I said it was simply pitiful how little the average man *did* know and he agreed with me. "Why, even in the foundry business," said he, "the condition of affairs is getting worse all the time. In the olden days, when we were young, a man had the opportunity to learn every branch of the trade. If he did not care to take advantage of it, that was his own fault. In these [illegible]r and degenerate days the bus[illegible] so divided and subdivided an[illegible]zed that a man only gets an[illegible]nity to learn one operation in the cycle that goes to make a casting. He is only a cog in the foundry gear wheel and if he drops out they can put a plug in his place. The all around foundryman will soon be classed with the dodo and the great auk. There soon won't be no such animal."



THIS WAS AFTER JULY THE THIRST

"Oh," I said, "I don't know about that, I heard the other day of at least one all around foundryman right here in town."

"I'd like to see him," said Bill, "where is he?"

"Well," said I, "I'll tell you all I know about him and then you can use your own judgment whether you want to go and see him or not. A friend of mine was out along Apahaukee avenue the other day selling foundry supplies. He saw a sign over a small building 'Brass Foundry,' and he attempted to enter. The place was locked but he was a determined kind of bird and besides his salesman's conscience (if there is such a thing) would give him no rest if he passed a foundry without attempting to make a sale. He knocked at the nearest house and a large colored lady came to the door with her sleeves rolled up and her arms wet from the wash tub. My friend bowed politely and asked the lady if she knew the foundry proprietor, or where he lived. She smiled on him expansively and said, 'Ah suah does, why ah owns him, he's ma husban an he lives right heah.' Our hero made known his business and asked if he might have the privilege of seeing him. 'Why, ce't'nly,' said she 'come right in an set down; he is out just now delivering de wash, he will be back in a hour or two and will be right pleased to meet yeh.' What do you think of that for an all around foundryman?"

"Sounds good," said Bill, "but I don't believe you. Your argument is irrevelant to the point at issue. When I spoke of an all around foundryman, I did not mean one who was all around the neighborhood. Neither had I reference to one who was all around like a beer barrel or a doughnut or a pint of half-and-half. What I meant was a man who had learned the foundry business thoroughly. The situation in the foundry industry is really becoming serious. So serious in fact that the United States government, through its depepartment of labor, is preparing to take action in the matter. In a preliminary report prepared by the department, it is pointed out that the supply of skilled foundrymen is entirely inadequate to cope with the present volume of business. It regrets that there is no apparent action by foundrymen to teach their employes and predicts a state of chaos when the present generation of foundrymen dies and the generation now growing up is placed in charge."

"You should change your name to Gloomy Gus," I said to him. "There is nothing to be alarmed about. The situation that is causing you and your friend, the department of labor, so much uneasiness is simply a case of times and methods changing. If we are young enough, we change with them and if we are not, we sit on the fence and grumble because things are not done the way they were when we were boys. All the grumbling in the world will not stop the march of events. So long as men have brains and use them either from pure love of achievement or for love of financial gain so long will industrial conditions keep changing. As for the industry withering up and dying for want of competent overseers and operatives after we take our hands off the wheel, I think you may let the undertaker take your measure any time. There were castings made on this old earth, thousands of years before the present generation of foundrymen howled their way into existence, and there is no reason why there should not be castings made after the last one of them has been permanently bedded in a pit six feet by two in the cemetery.

"The day of the all around molder or foundryman has gone by. The tendency in the foundry as in every other business is to divide every operation into its component parts, in order to employ more men and get a larger output than would otherwise be possible. In this way a minimum of individual skill is all that is required on the part of the operatives.

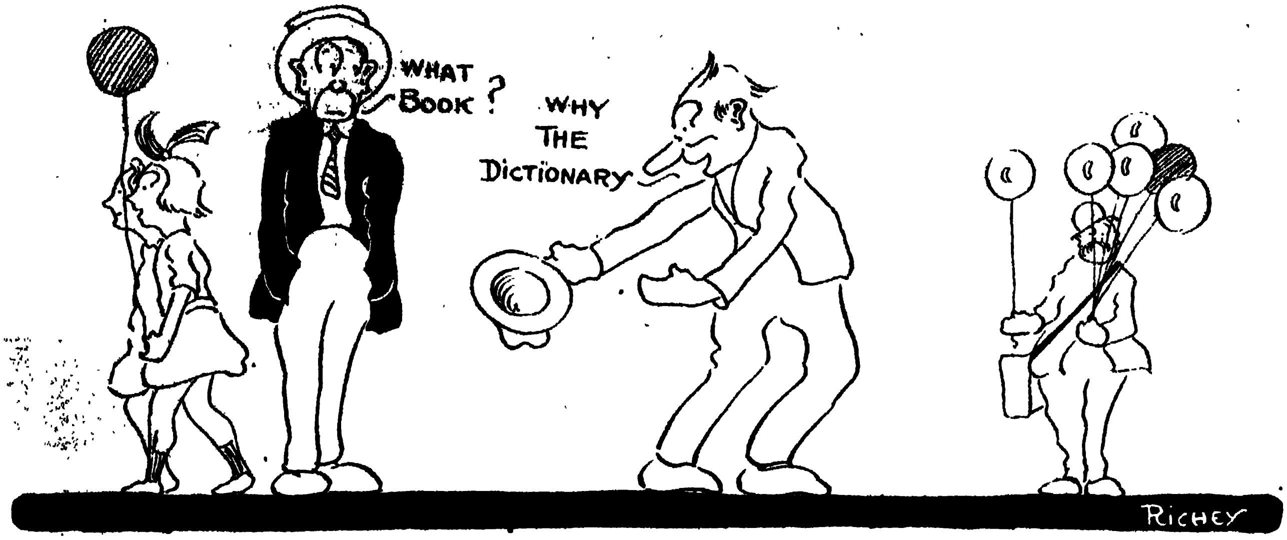
"The men in charge of foundries need to have a general knowledge of foundry operations but not necessarily an intimate knowledge of all the details. The boys who are destined to become foremen and superintendents will find ways and means to get the necessary information. It is not the man who knows the most, who is the most valuable. It is the man who knows how to use what he knows. Grant did not have any reputation as an A-1 all around soldier when Lin-

[illegible] for him, but he made a pretty good job of a certain little proposition that was put up to him. Neither Lincoln or Cleveland learned their trade in a modern president factory but you must admit that they were competent journeymen presidents. They had brains, ambition, courage and a sense of justice, and that is a combination that will land a man in the front rank either with or without training, when it is applied."

"Good night," said Bill, "if you are going to drag politics into the thing you can count me out. Besides that peroration of your's is all second-hand stuff; I saw every word of it in a book I have at home."

I indignantly dared him to prove it and asked him what was the title of the book in which he had seen it.

"The dictionary," said he, with a rather sarcastic grin.



How and Why in Brass Founding

By Charles Vickers

Proper Sand for Brass Castings

We operate a small brass foundry and have been advised by one of our customers that we could produce finer brass castings if we used a French sand. We have tried to secure some of this sand but so far without success. Can you advise us where to procure it? Also we would appreciate any advice concerning the best sand to use for fine brass castings.

French sand would be entirely unsuited to the class of castings being made in a small ordinary foundry. This sand is used in making statuary because it can be hammered against a pattern until so compact it will not break or tear when the section is removed. It is not suitable and is too expensive for ordinary molding. If an exceedingly fine grade of sand is desired, Windsor Locks as it is known would be suitable, and it can be obtained from any large foundry supply house. We are of the opinion, though, that satisfactory castings can be made by using ordinary brass molding sand make a specialty of fine grades of brass sand. Probably the sand now being used is of too coarse a grade and if this is found to be the case on comparing with the fine sand, all the old sand should be thrown aside or be stored and used in coremaking. Do not mix it with the new and finer sand, otherwise the castings will show little improvement.

High Pressure Alloys

We have lately experienced difficulty in getting castings that will not leak under air pressure. We have tried an alloy of copper 90 per cent; phosphor tin 10 per cent. The phosphor tin contained 5 per cent phosphorus, and thus added 0.5 per cent phosphorus to the alloy. Another alloy tried was copper, 88 per cent; tin, 10 per cent, and zinc, 2 per cent, but both alloys leak at 500 pounds air pressure. We are careful in melting the metals, using plenty of charcoal, and have tried both oil-fired and coke-fired furnaces with the same results. We make the cores with flour as a binder, making them weak, then spray with linseed oil to produce a skin.

It contained too much phosphorus, and the 88-10-2 is notoriously a difficult alloy to withstand pressure. If necessary to use one of the two alloys that have been tried, select the first one mentioned, but instead of usin[illegible] phosphor tin, change the formul[illegible]er 90 per cent; common tin, 8[illegible]; phosphor tin, 2 per cent, an[illegible]tle lead can be added, about 2 per cent, in place of 2 per cent copper or even 2 per cent of tin, the alloy will be improved. The following alloy, however, has been very successfully used for castings subjected to air pressures. Copper, 82 per cent; tin, 7.50 per cent; zinc, 5 per cent, and lead, 5.50 per cent. See that the castings are made with extra high heads to give plenty of pressure to the metal and pour with the metal hot.

Bushings of Copper Alloys

We have experienced considerable difficulty in making bushings of an alloy of copper, 80 per cent; tin, 10 per cent, and lead, 10 per cent. We exercise all reasonable care in melting and molding, using charcoal on the metal, and working the sand as dry as possible, but the *holes. How can we remedy this condition? We also would like to learn where we can obtain reliable information concerning the state of the copper market.*

There is a possibility that the porosity of the bushings is due to high sulphur in the fuel used in melting the metal. This will result in a furnace atmosphere strongly impregnated with sulphur dioxide gas, which will be absorbed by the copper if the charcoal covering burns away and exposes the metal to the furnace gases. This gas is also formed in the copper when sulphur and oxygen come into contact, and as the copper takes up both these elements readily, the gas is easily formed in the copper. This is a simple explanation of how the gas is formed; in reality the reactions are probably quite complicated. To prevent the formation of holes, the metal must be protected from the two elements that cause them. This can be done by covering the metal while melting with a tenacious flux, such as a mixture of powdered glass, borax and charcoal. Use about one part borax and charcoal to eight parts powdered glass.

Reliable information concerning the copper market can be obtained daily by subscribing to the *Daily Iron Trade and Metal Market Report*, Penton building, Cleveland, O. The subscription is $10 per year.

Cracking of Aluminum Crank Case Castings

We have experienced difficulty in casting a four-cylinder aluminum crankcase, about 18 by 9 inches in size. The inside of the case is cored out and although we have made the core as soft as possible consistent with sufficient strength for [illegible]ing, the casting cracked over th[illegible]cross almost the entire side, [illegible]e got the core out as soon as [illegible] after casting. Could you recommend a core mixture suitable for this casting, or would you suggest that a wedge-shaped arbor be placed in the core, and then be withdrawn as quickly as the cope could be removed from the poured mold?

It is seldom that a casting can be released from the sand after being poured in time to permit it to shrink without cracking, because it is necessary to wait until the metal is no longer liquid before the mold can be removed, and with most metals and alloys the contraction has then taken place, and the crack has formed if it is going to form. Aluminum bronze is an exception to this rule and that is why it can be used for die-castings. After solidification there is an appreciable interval before it contracts, and if the die is opened the casting is removed without difficulty, but if this is not done in time the casting will grip the mold firmly and be difficult to eject, and may possibly be broken.

Aluminum is tender as it congeals, but in spite of this complicated cored castings are made continually without cracking. The important thing is not to pour too hot. For a thin casting pour at 1300 degrees Fahr., by pyrometer, and use a core that is more easily burnt than an oil sand core. Such a core is a flour sand core, surface hardened by spraying with molasses water.

Difficulties With Fire-Hose Couplings

We have experienced some difficulty in making fire hose couplings. The work proceeds satisfactorily for a period of months, then we have trouble with excessive breakage, the castings are found to be perfectly sound, but crack under expansion. Our formula consists of copper, 89 per cent; zinc, 5 per cent; lead, 4.5 per cent, and tin, 1.5 per cent. We use no scrap metals outside of our own turnings and gates. We would appreciate advice in regard to this matter.

The difficulty being intermittent would indicate that some impurity occasionally gets into the metal and produces brittleness. If the alloy were a yellow brass, antimony would cause this difficulty when present in fractions of 1 per cent. With the alloy used, however, it is difficult to see how antimony can produce this breakage unless it is present in proportions higher than 1 per cent. The only certain way for discovering what causes the trouble is to have analyses made. Have a normal casting analyzed, then when the castings begin to fail by breakage, have the broken castings analyzed and compare the analysis with that of the normal casting. If antimony is found in the broken casting and not in the other, it will be evident what has caused the difficulty. Whatever it is the analysis will detect it and is the cheapest way of running down the difficulty.

Benedict Nickel or Benedict Metal?

We have an inquiry for an alloy known as "Benedict" metal and we would like to obtain the formula for the same. We have the formula for "Benedict" nickel, but this is not the mixture required. We assume the mixture is similar to the admiralty metal, copper, 70 per cent; tin, 1 per cent; zinc, 29 per cent.

"Benedict" nickel is an alloy of copper and nickel the proportions of which may vary within considerable limits, but usually it is composed of copper, 80 per cent, nickel 20 per cent. It is a rolling mixture and is used for tubing connected with plumbing fixtures, because it is white and maintains a creditable appearance after the nickel plating has worn off. "Benedict" metal is simply another name for "Benedict" nickel, and applies to the same mixture. However, it is possible that locally the name might be applied to any composition, therefore, if it is reasonably certain that a yellow brass is desired, the mixture mentioned could be used. Instead of regular admiralty metal it would be advisable to use some mixture that casts well. If the castings are to be machined, the following mixture would give satisfaction: Copper, 70 per cent; zinc, 25 per cent; tin, 2 per cent, and lead, 3 per cent. It would be advisable to get a sample of this particular "Benedict" metal, and if it has a white color, it is a copper-nickel alloy; if yellow, a copper-zinc alloy, when the above mixture should be used, and if it is gold color, it is a red brass, and any ordinary mixture of red metal such as copper, 85 per cent; tin, 5 per cent; zinc, 5 per cent; lead, 5 per cent, would prove satisfactory.

Properties of Nickel-Copper Alloys

Kindly advise us regarding copper-nickel alloys such as copper 98 per cent, nickel, 2 per cent We are confused in regard to the proper pouring temperature for these alloys.

According to Hiorns there are no chemical compounds of copper and nickel, neither is there any eutectic mixture, as the two metals form solid solutions or mixed crystals in all proportions. All the alloys with excess of nickel are magnetic, and those with excess of copper are nonmagnetic. Soft drawn alloys of copper 98 per cent, and nickel 2 per cent, have a tensile strength of 32,200 pounds per square inch, and when hard drawn, 53,392 pounds tensile strength. With 5 per cent nickel the tensile strength of soft drawn material is the same as the 2 per cent nickel alloy, and at 25 per cent nickel, the tensile strength is around 60,000 pounds per square inch.

In casting an alloy of copper 98 per cent and nickel 2 per cent, treat it in every respect the same as pure copper as the content of nickel is too small to have any effect from a foundry standpoint. The copper-nickel alloy will require deoxidizing exactly the same as in the case of pure copper, otherwise the castings in sand molds will be spongy. Either silico-calcium copper or magnesium-phosphor copper should be used in deoxidizing copper for shell bands, otherwise its ductility will be low.

Where Converter Castings Are Made

Cupolas Used for Melting the Metal in Converter Steel Foundries Show Remarkable Performance When Compared With the Practice Current in Most Gray Iron Shops

WHEN Henry Bessemer conceived the idea and later put into actual practice the principle of blowing a current of air through a quantity of molten iron thus converting it into steel, it is doubtful if he realized what a tremendous impetus the invention was to give to world trade. The development and importance of the steel industry may be likened to a certain extent to the career of the distinguished inventor.

There are many foundries in this country which make steel castings by the bessemer process exclusively, and of these the Burnside Steel Foundry Co., Chicago, is fairly representative. This company specializes in railway and traction work, but also does a general jobbing business in small and medium sized castings. The plan, Fig. 4, shows the arrangement of the plant and the location of various units that enter into the manufacturing activities. The building covers 31,600 square feet which may be divided into four sections. Reading up and from left to right they are: The molding floor, 180 x 60 feet; sand blast and cleaning room 100 x 20 feet; and the main bay 280 x 40 feet, one end of which is devoted to molding and the other to cleaning the castings. The section of the building shown in the upper part of the plan 280 x 20 feet is occupied by the core ovens, core room, cupolas and converters, the power house, arc welder and annealing ovens. This wing of the building as well as that portion housing the sand blast and tumbling barrels on the opposite side are extensions to the main building. The buildings are of steel frame construction with the roof and ends covered with corrugated sheet steel. The outside wall between the columns is built of brick to a height of four feet. From this elevation to the roof is one continuous window sash extending the entire length of the building. Fig. 3 indicates the excellent lighting and ventilating facilities thus afforded. The columns are 20 feet apart on the center lines, and between each pair are twelve 6-pane sections of windows which are hung on pivots and can be adjusted from the floor. Fig. 3 also shows a section of the shop where the light work is made. A day's supply of cores for one of the jobs which is going through on a production basis is piled in the foreground. This part of the shop, as may be seen from the plan, Fig. 4, is equipped with 11 molding machines of various types and makes There are six Buch hand jolt and squeeze, one jolt squeeze and pattern draw constructed by The Arcade Mfg. Co., Freeport, Ill., two Osborn jolt and squeeze, and two plain squeezers from the Federal Foundry Supply Co., Cleveland. In addition to these there are two heavy-duty jolt roll-over pattern draw machines in the main bay, built by the Cleveland-Osborn Mfg. Co., Cleveland.

Nearly all the work is light and is poured in green sand. Some of the molds made in the bay devoted to heavy work are poured green and some of them are skin dried. It depends more on the shape of the casting than on the weight, whether the mold is to be dried or not.

Fig. 2 illustrates the machine on which grousers are made for caterpillar tractors. It is Buch combination hand jolt rollover pattern draw which takes both cope and drag at one time. In the illustration the cope and drag are ready to be taken away from the machine and set on the floor. After they are lifted, the platforms on which they are resting will be swung in under, to receive the pattern boards. An ingenious roll-over clamping device is in use on this machine. W[illegible]he cope and drag [illegible]med and th[illegible] boards in place the bar *A*, Fig. 2, is laid across with the pads *CC* resting one on each bottom board. The clamp *B* is then swung upright, the gap in the clamp engaging the bar *A*. The ends of the bar instead of being round, are eccentric; therefore by a turn of the handle *D* the bar is locked. The end of the clamp bolt is threaded and therefore it may be adjusted to fit flasks of different heights. The pattern and flask repair shop is located in a closed balcony at one end of the light work bay. In

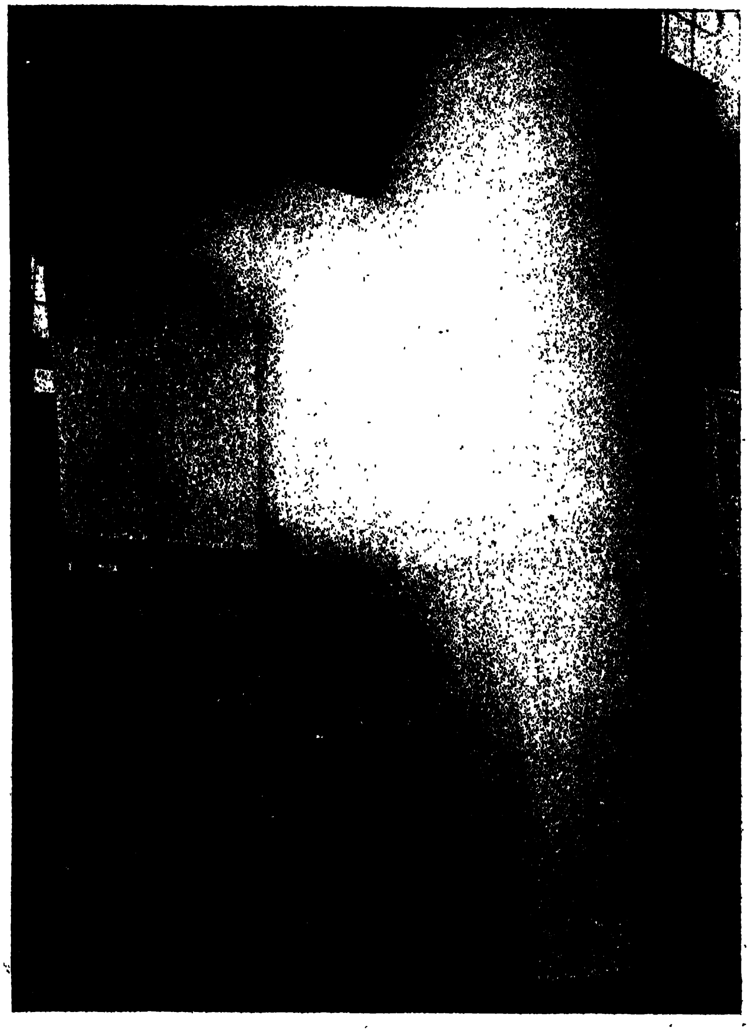


FIG. 1—NEARLY READY TO TIP AND POUR—THE BESSEMER CONVERTER IN ACTION

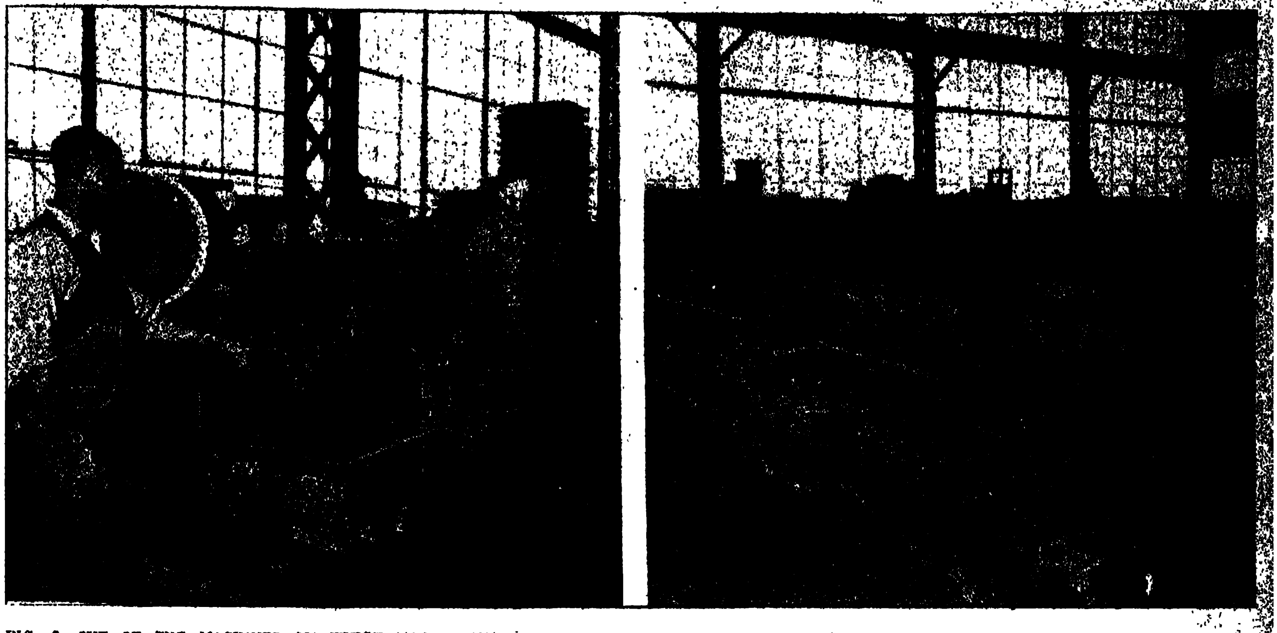


FIG. 2—ONE OF THE MACHINES ON WHICH THE GROUSER MOLDS ARE MADE—NOTE THE CLAMPING BAR A FOR HOLDING COPE AND DRAG WHILE TURNING. FIG. 3—A DAY'S SUPPLY OF CORES FOR TWO MACHINES

addition to the equipment of an ordinary pattern shop a miniature aluminum and brass foundry is provided in which to make or repair metal patterns. The quantity of metal used at any one time, of course, is not large and is melted in a small open gas-fired furnace.

One-third of the main bay is devoted to medium sized and heavy work, and is served by a 7½-ton Northern crane. Here also is located a 6-foot Simpson grinding pan for mixing the facing sand for the molders and two jolt roll-over draw machines made by the Cleveland-Osborn Mfg. Co., Cleveland. These are utilized when there is a large number of molds to make from one pattern. Most of the work made on this floor consists of miscellaneous parts with only one or two molds of a kind. Some of the castings in this bay are poured in green sand, but most of the molds are skin dried. Gas torches are used extensively for this purpose, although in some instances charcoal is found to be more convenient. Frequently both methods are used on the same mold; the gas torch on the drag and the charcoal fire under the cope.

The method of handling molten steel is illustrated in Fig. 5. The tap ladle is taken from the converter by the crane and set on the pouring stand shown. From this stand metal is distributed all over the shop in bull ladles. This applies only to the light work. The heavy castings, of course, are poured direct from the crane ladle. Unless otherwise specified the heavy castings are poured last from each heat. This is to secure a higher carbon content in the heavy than the light castings. In the converter the carbon is blown down to 0.18 per cent or 0.20 per cent or even lower for some classes of work. It is poured from the vessel into the ladle and a certain amount taken to pour the light castings. After a given amount has been taken out it becomes necessary to raise the carbon to a point suitable for the heavier castings. For this purpose a

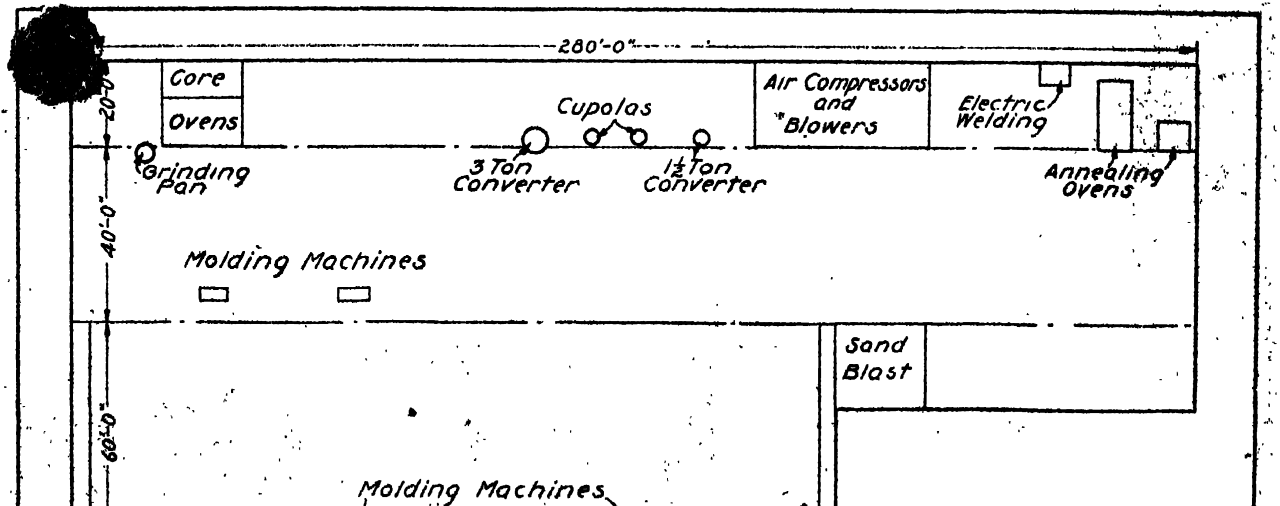


FIG. 4—PLAN OF THE FOUNDRY SHOWING THE LOCATION OF MOLDING MACHINES, CORE ROOM, MELTING UNITS, POWER HOUSE AND ANNEALING OVENS

FIG. 5—THE STEEL MAKING INSTALLATION—THE 28-INCH FURNACE SUPPLIES IRON FOR THE 1½-TON CONVERTER AND THE 42-INCH CUPOLA SERVES THE 3-TON VESSEL

ladle of iron is brought direct from the cupola and enough of iron transferred to the ladle of steel to bring the carbon to the desired point.

The converter at the left, in Fig. 5, blows a 2000-pound charge in about 15 minutes. When the color of the flame indicates that the proper carbon content has been reached, blowing is stopped and the steel poured into the ladle. Here the ferrosilicon and ferromanganese are added to bring it to the desired analysis. The converters are equipped with direct connected electrically operated tilting machinery. There are two cupolas and two converters in this shop, each pair constitutes a complete steel melting unit in itself. At the time the photograph was taken only the smaller one was in commission. The large converter is served by a 42-inch cupola and has a rated capacity of 6000 pounds. The smaller one is served by a 28-inch cupola and blows 2000 pounds each heat. At an average of three heats an hour that means that the 28-inch cupola has to supply nearly 8000 pounds of iron every hour for 6 or 7 hours a day, and not only for one day but for every day in the week. Iron foundrymen who have trouble with their furnaces could derive a great deal of profit by taking a leaf out of this steel foundryman's book. In fact a performance that would be regarded as remarkable in most iron foundries is here treated as a matter of course. Getting 20 tons of iron out of a 28-inch furnace in 6 or 7 hours is looked upon as an ordinary part of the days work.

In the illustration, Fig. 5, it will be noted that the windbox is considerably higher than is usual in furnaces of this size. The slag hole is 15 inches above the sand bed, which means that the furnace holds approximately 1800 pounds of iron before each tap, and therefore two taps will form a charge for the converter. The size of the furnace and the speed of the melting in an installation of this kind depends altogether on the ability of the converter to take care of the metal. The furnace charge consists of 60 per cent steel scrap in the form of shop scrap, draw-bar knuckles and coil springs. To this is added 40 per cent low phosphor pig iron. The

FIG. 6—OWING TO ITS EXTREME FLUIDITY ALL THE METAL IS POURED OVER THE LIP OF THE LADLE

charges are comparatively light, 500 pounds constituting a standard heat. On account of the high percentage of steel in the charge and of the high temperature required, the ratio of coke to iron averages about 5 or 6 to 1. A shovelful of limestone is thrown on each charge for flux. A blast pressure of 10 ounces is maintained throughout the heat and is supplied by a positive pressure blower. The ladles of iron are taken from the furnace to the converter by the crane. After the metal is blown the cranes again take it away. The analysis of the steel for most of the work is 0.18 per cent carbon, 0.30 per cent silicon, 0.08 per cent sulphur, 0.05 per cent phosphorus and 0.65 per cent manganese. The carbon is sometimes raised to as high as 0.80 per cent for large work and for special castings.

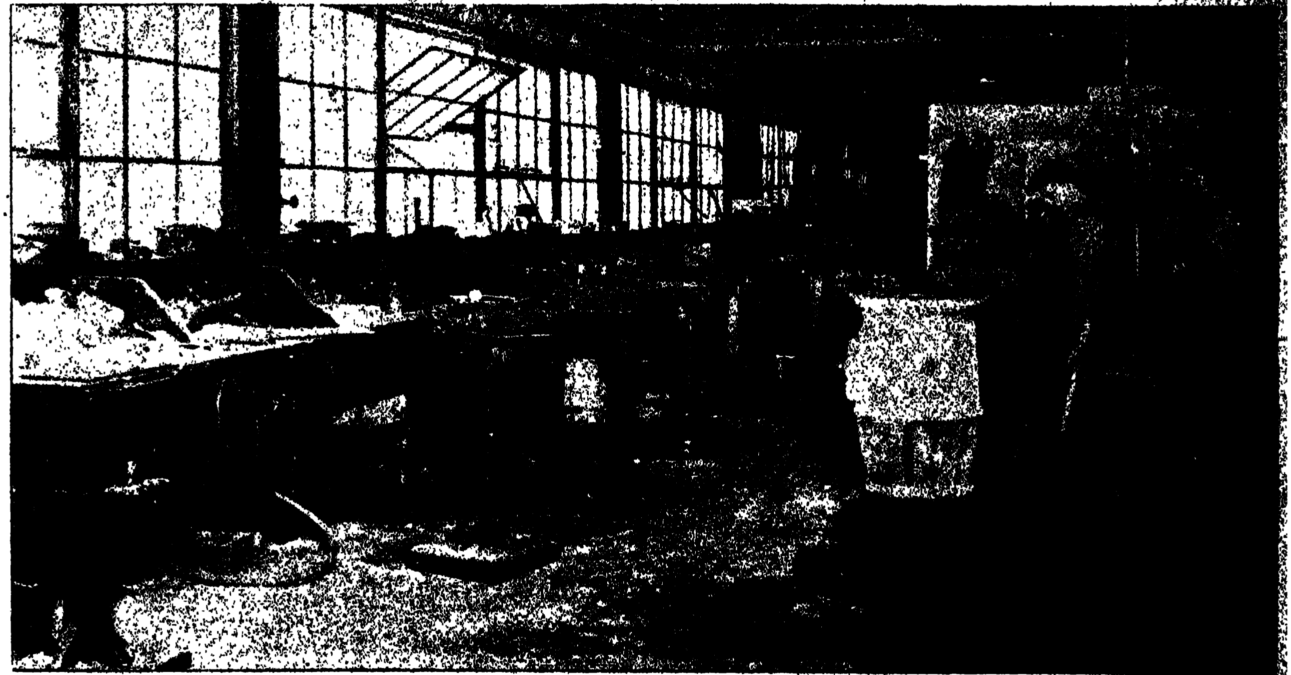


FIG. 7—THE CORE ROOM—A STAND AT EACH COREMAKER'S BENCH SERVES TO HOLD HIS PLATES

The cupola charging floor is served by a hydroair elevator. Adjacent to the elevator there is a cylindrical tank 4 feet in length by 20 inches in diameter which is kept filled with water in summer and oil in winter. From this tank one pipe leads to the elevator cylinder and another to the air supply line. By opening [illegible] the oil or water, as the case may be, is forced into the cylinder causing the platform or cage to rise. By opening the release valve the air escapes, the platform descends by gravity and forces the oil or water back into the tank again.

[illegible] pig [illegible] scrap are [illegible] from the s[illegible] frame [illegible]ows [illegible] one [illegible] on two 18-inch wheels. This style of barrow is a comfortable height for loading and unloading. It also is capable of transporting about twice the load possible with the type of barrow having one wheel. A spur track runs alongside the building and all the raw material, iron, coke, limestone, sand, etc., is unloaded and piled close to the building.

The powerhouse is partitioned off from the rest of the building. The equipment consists of two angle-compound air compressors manufactured by the Sullivan Machinery Co., Chicago. These have a rated capacity of 450 and 1100 cubic feet of air a minute, respectively. The blowers for the two converters and for the 28-inch cupola were built by the P. H. & F. M. Roots Co., Connersville, Ind. The blower for the 42-inch cupola is a General Electric centrifugal blowing unit. The cupolas operate on a 10 or 12-ounce blast, but the converters require from 2½ to 4-pound pressure.

The facilities for cleaning the castings are quite ample. They include a sand blast room 10 x 12 feet, manufactured by the Pangborn Corp., Hagerstown, Md.; one combined tumbling barrel and sand blast made by the Whiting Foundry & Equipment Co., Harvey, Ill.; and two [illegible] barrels by the W. W. Sly Mfg. Co., Cleveland. There is also a Milwaukee power sprue cutter and a 600-ampere electric arc welder.

There are two annealing ovens built by the American Foundry Equipment Co., New York. [illegible] In the other the castings are piled directly on the floor of the oven. Both of the ovens are heated by gas. In the large oven the gas enters through three ports in one of the side walls immediately under the roof, and is deflected downward. In the small oven the combustion chamber is under the floor. In both cases the castings are gradually brought to a temperature of 1600 degrees Fahr. This temperature is maintained for two or three hours depending on the size and general characteristics of the castings undergoing treatment. It is then allowed to drop. When the temperature reaches 1000 degrees Fahr. the castings may be taken out, but they are generally left until they are cold enough to handle.

The core room occupies the space along one side extending from the large converter to the end of the building. Oil sand cores are used throughout. The sand for them is mixed by hand and then passed through a Combes gyratory riddle. Fig. 7 shows the core benches and stands for holding the green cores. When commencing work each man places six plates on his stand. He fills the top plate with cores and carries it to the oven and keeps repeating the operation until all the plates are used. He then gets a fresh supply of plates. The cores are dried in three gas-fired ovens. Two of the ovens are of the drawer type since nearly all the cores are small. There is, however, a large oven with a car in which to dry the large cores. This oven [illegible] at slightly higher [illegible] than the smaller ovens in order to heat the large cores through to the center more quickly.

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Systems Change With the Times

EVENTS have moved rapidly during the past decade. There is not such a sharp line of demarcation between the shop and the office as there once was. In one way the recent war has been a blessing. It has dragged out of their hiding places and off their pedestals many a hoary fetish and belief; it has turned the light of ridicule on many a selfish proposition and punched full of holes the armor of conceit in which some long established practices were wont to take refuge. The foundryman who keeps abreast of the times know and recognizes these facts and adapts himself to meet them. He cheerfully scraps tools and processes when they become obsolete and just as cheerfully he scraps systems of management which might have been perfect in his father's time but which he knows are not in harmony with existing conditions. The spirit of co-operation and the square deal are spreading.

Light on Nonferrous Metallurgy

DURING the war a prominent foundry in the Middle West was asked to make eight hundred aluminum crankcase castings for airplane engines. The patterns were fitted up carefully and eight hundred molds were poured, but only three hundred and eighty good castings resulted. Experiences like this are not uncommon in nonferrous shops, specially when dealing with alloys of aluminum. Stories are current to the effect that certain foundries hold their average losses to less than 10 per cent but they are mostly myths. As a matter of fact aluminum is a difficult metal to handle and while losses do not usually exceed 50 per cent, as in the instance cited, they are prone to be heavy even under the most satisfactory conditions.

The situation, however, is creating its own remedy. Scientific research in the metallurgy of aluminum alloys is being stimulated on a large scale. In addition to the splendidly equipped and ably manned laboratories maintained by producers of aluminum products, such as that of the Aluminum Castings Co. described in our June 15 issue, the government is taking up the problem through the bureau of mines. Some of the first fruits of this effort are made available in this issue in an article on "Unsoundness in Aluminum Castings," by Robert J. Anderson. Mr. Anderson believes that porosity is one of the chief difficulties that must be overcome in connection with the development of satisfactory aluminum foundry conditions. His experiments indicate that porosity is a function of the pouring temperature, the maximum temperature to which the charge was heated in the furnace, and the length of time required to melt the charge. Mr. Anderson's conclusions are tentative but they point the way to an interesting and profitable field of investigation, which, it is to be hoped, will be more thoroughly explored.

As Mr. Anderson says, porosity is no myth, and his statement is corroborated by the figures on aluminum foundry losses presented in our July 1 issue. One of the most encouraging features of the government's investigation of this problem lies in the fact that the results of its work are public. There has been too much mystery in the past regarding nonferrous metallurgy. An atmosphere of alchemy is not conducive to progress.

Trade Outlook in the Foundry Industry

THE tide of orders for castings continues to rise and the books of some gray-iron foundries are overflowing. Prices of both raw materials and castings are less sensitive to small fluctuations in demand than was the case a few months ago. This relative stabilization of the price situation, even though it be temporary, is a business factor of considerable importance. Generally speaking, the world's production of commodities is increasing as a result of the tendency to restore normal conditions, and after the first rush of post war demand is over a gradual price liquidation must follow.

Orders Going East

Automobile and tractor manufacturers in the Middle West have exhausted the capacity of the foundries in their immediate district, and as a result inquiries for large quantities of gray-iron cylinder and other motor car castings are finding their way east. This is one of the most notable developments in the casting market. One inquiry now pending in the east calls for numerous different kinds of castings, and the number of castings in each classification ranges from 15,000 to 20,000. Another inquiry almost as large is also current. It is not known whether any eastern casting shops are considering these inquiries seriously, since the booking of the orders would necessitate considerable floor space and the purchase of a large amount of additional equipment. Additional labor also would be required. It is stated, however, that if this business is placed in the east, it will remain there permanently, the buyers agreeing to place orders regularly in the future with eastern foundries. It is not unlikely, therefore, that a few eastern plants may be prevailed upon to provide the necessary equipment to handle this work. Although the gray-iron foundry business is exceedingly good in all sections of the country, it is probably showing more activity in the east than elsewhere and in addition to the automobile work just mentioned, numerous other orders are in sight. A great improvement in conditions is reported by producers in Newark and other northern New Jersey districts. The foundries in that territory have as much work as they can handle. While prices on castings in the Newark district have not changed materially in the past two weeks, they continue strong and there is no longer any disposition to cut quotations. In metropolitan New York where unsatisfactory conditions have been noted previously, considerable improvement has taken place. Foundries in this territory devoted to the production of ornamental iron work, which have been running very slack, now say that orders for castings are beginning to appear in greater volume. As a result these foundries also are less eager to cut prices, although some shading still is being done. In the Cleveland and other central western districts, the volume of inquiries for iron castings shows no abatement and similar conditions are noted in Mississippi valley territory. Prices are firm throughout the country.

Labor is Scarce

One of the principal problems occupying the attention of foundrymen in various sections of the country is the shortage of workers of all kinds, particularly unskilled labor. For five years there has been practically no immigration and since the first of the year emigration has been considerable. The effect of this situation is becoming more and more pronounced in the unskilled labor market as time goes on. Because of the shortage of unskilled labor and handymen suitable for operating machines, it is difficult to maintain operations, even where the foundries have plenty of work on their books. Of course, these conditions add to the instability of the labor situation. Wages, however, are fairly steady for the time being and in districts where union shops are operated it is not expected there will be any change in current rates until existing agreements expire. Along the eastern seaboard the number of men applying for work is very small and the usual floating supply of molders and common laborers is almost nonexistent.

Prices Of Raw Materials for Foundry Use

CORRECTED TO AUG. 21.

Iron	
No. 2 Foundry, Valley........	$26.75
No. 2 Southern, Birmingham...	27.50
No. 2 Foundry, Chicago.......	26.75
No. 2 Foundry, Philadelphia...	28.50 to 29 50
Basic, Valley	25.75
Mal'eable, Chicago	27.25
Malleable, Buffalo	27.25

Coke	
Connellsville foundry coke........	5.50 to 6.50
Wise county foundry coke........	6.50 to 7.50

Scrap	
•Heavy melting steel, Val'ey....	$21.00 to 21.50
Heavy melting steel, Pittsburgh.	21.00 to 21.50
Heavy melting steel, Chicago....	20.00 to 30 50
Stove plate, Chicago..........	25.00 to 25.50
No. 1 cast, Chicago...........	27.50 to 28.00
No. 1 cast, Philadelphia.......	25.00 to 26.00
No. 1 cast, Birmingham.......	24.00 to 25.00
Car wheels, iron, Pittsburgh....	25.00 to 25.50
Car whee's, iron, Chicago......	24 50 to 25.00
Railroad malleable, Chicago.....	23.50 to 24 00
Agricultural malleable, Chicago..	21.50 to 22.50

Raw Material Markets

The rush for pig iron which has been in evidence during the past month, has subsided to some extent, although the demand for all grades suitable for casting purposes, continues heavy. Most producers are booked up for the remainder of the year. It is now believed in the Middle West that some shortage may be felt later in the year as inquiry is still active in the Chicago territory and many melters apparently have not covered. Prices are about $1 a ton higher in the south. Scrap quotations, however, are generally low owing to larger offerings from country sources. The coke market has experienced a radical change in the past two weeks and instead of being in the buyer's favor, it is now tending strongly toward prices in effect during the period of government control. The transition of the coke market from a condition of weakness to one of strength may be ascribed to the fact that fear of a shortage later in the year has prompted considerable buying for stock. Buying of nonferrous metals is on a comparatively small scale. The shortage of labor has curtailed the production of copper, zinc and lead. Prices of nonferrous metals are moving within relatively narrow limits. New York quotations are as follows: Casting copper, 22.50c; lead, 5.90c to 6c; tin, 56c; antimony, 8,75c; aluminum, No. 12 alloy, 28c.

Comings and Goings of Foundrymen

EUGENE F. BALL, who was re-elected president of the National Association of Pattern Manufacturers at its cond annual convention, held at the otel Statler, Buffalo, Aug. 16-17, is eneral manager of the Newark Stamp-g & Foundry Co., Newark, O. Mr. all enters his third term as president, aving held that office in the original rganization, known as the Inter-State ssociation of Pattern Manufacturers, hich became the National association 1918. It was at the suggestion of Ir. Ball and E. O. Melvin of Columbus, ., that an organization of this charcter was started and proof of its popuarity is found in the fact that in the ast year its membership has grown rom 28 to over 200.

L. G. Williams, East View Farm, . 6, Box 50, Hopkinsville, Ky., is oranizing a company to build a plant in klahoma for the manufacture of farm nd mining machinery. A small foundry quipped with modern devices, an up-toate brass foundry, machine, blackmith's and forge shops, equipped with abor-saving appliances and automatic achinery, and a pattern shop with odern wood-working equipment all are ontemplated.

W. L. Shaughnessy and J. P. Carney of he William L. Shaughnessy Co., Gardner, Mass., manufacturer of casket hardware, recently purchased the foundry, perated by Lord, Stone & Co., Otter River, Mass. They will form a new ompany, incorporated at $50,000, to be nown as the Otter River Foundry Co. They will continue the manufacture of toves, which the foundry has been producing for a number of years.

F. J. McGrail, who has had charge of he foundries of the Honolulu Iron Works Co., Honolulu, Hawaii, for some ime, formerly was with the Henry R. Worthington Pump Co., Harrison, N. J., and for eight years was foundry superntendent of the Struthers-Wells Co., Warren, Pa., resigning that position to ocate in Honolulu last May.

Edward Shearson of Shearson, Hammill & Co., New York, resigned recently as director of the American Steel Foundries.

I. F. Blank, who recently resigned from the bureau of mines, where he was doing experimental work in connection with the extraction of helium from natural gas for use in balloons, now is identified with the Wilson Foundry & Machine Co., Pontiac, Mich., doing foundry efficiency work and assisting the foundry engineer in foundry methods. Mr. Blank enlisted in the chemical warfare service division in September, 1917, and was discharged as a lieutenant in January, 1918, when he accepted the position in the bureau of mines. Prior to his enlistment, he was connected with the methods department of the Western Electric Co., Hawthorne station, Chicago, having charge of the methods and efficiency work in its foundries.

George N. Peek, formerly vice chairman of the war industries board and former vice president of Deere & Co., Moline, Ill., has been elected president and general manager of the Moline Plow Co., to fill the vacancy caused by the retirement of Frank G. Allen, who was its head for many years.

EUGENE F. BALL

C. Bateman Swasey was recently elected treasurer of the Belcher Malleable Iron Co., Easton, Mass. Formerly Mr Swasey was superintendent of the Gorham Mfg. Co.'s Allen avenue plant, Providence, R. I.

Lieut. Clifford L. Snyder, who recently was discharged from the army, has become affiliated with the technical staff of the Detroit Testing Laboratory as sales engineer. Lieutenant Snyder received his commission at Fort Sheridan, Illinois, and later was transferred to the nitrate division in charge of construction work at plant No. 1, Sheffield, Ala.

H. C. Southgate, formerly local treasurer of the Chicago works of the National Malleable Castings Co., Cleveland, who has been absent from the organization for the past seven years, has returned to the Chicago works as assistant local treasurer.

Andrew K. Barr has been made foundry superintendent at the Wakefield, Mass., branch of the Gibby Foundry Co., Boston. He formerly was foreman patternmaker with Davis & Furber Machine Co., North Andover, Mass., since January, 1913.

M. W. McClane was elected president of the Aetna Foundry & Machine Co., Warren, O., at a recent annual meeting of stockholders. Mr. McClane, W. M. McKee, G. P. Gillmer, V. E. Rehr were elected directors. Mr. Rehr was also elected vice president; G. P. Gillmer, treasurer, and M. C. Boyd, secretary.

Judge Will Cummings was elected president of the Southern Foundry & Machine Co., Chattanooga, Tenn., at its recent organization. E. D. Herron was elected vice president and general manager.

Albert A. Smith of Albert Smith & Co., Glasgow, Scotland, foundry engineers and machinery merchants, has arrived in the United States to visit American manufacturers of labor-saving machinery suitable for use in foundries and patternshops, for which, he says, there is a large market in Great Britain.

J. H. Hogue, formerly affiliated with the Great Western Mfg. Co., Leavenworth, Kans., assumed his duties as foundry superintendent for the French Oil Mill Machinery Co., Piqua, O., on Sept. 1.

E. W. Wallbank has been made superintendent for the Parkersburg Rig & Reel Co., Parkersburg, W. Va. He formerly was tool designer with the Savage Arms Corp., Sharon, Pa., and prior to that time was foreman machinist with the New York Yacht & Engine Co., New York City; foreman patternmaker with the Producers' Supply Co., Franklin, Pa.; and tool designer with the General Electric Co., Erie, Pa. He also has contributed various articles on patternmaking and molding methods to THE FOUNDRY.

Carl F. Dietz was appointed vice president and general sales manager of the Norton Co., Worcester, Mass., in the reorganization which followed the combining of the Norton Co. and the Norton Grinding Co., noted in the Aug. 1 issue. W. LaCoste Neilson was appointed vice president and foreign manager; Herbert Duckworth and Howard W. Dunbar, sales managers of the grinding wheel and grinding machine divisions, respectively; John C. Spence and Charles H. Norton, superintendent and chief engineer, respectively of the grinding machine division.

J. L. Dixon, formerly connected with the John A. Crowley Co., now is associated with the T. W. Price Engineering Co., Woolworth building, New York, as metallurgist and electric furnace engineer. Mr. Dixon has had a wide experience in the design, installation and operation of electric furnaces for foundries covering a period of over 11 years. The T. W. Price Engineering Co. will continue the construction and installation of electric furnaces.

James Savage, formerly of Brooklyn N. Y., now is foundry superintendent for the Atkinson Co., Rochester, N. Y., successor to Clum & Atkinson.

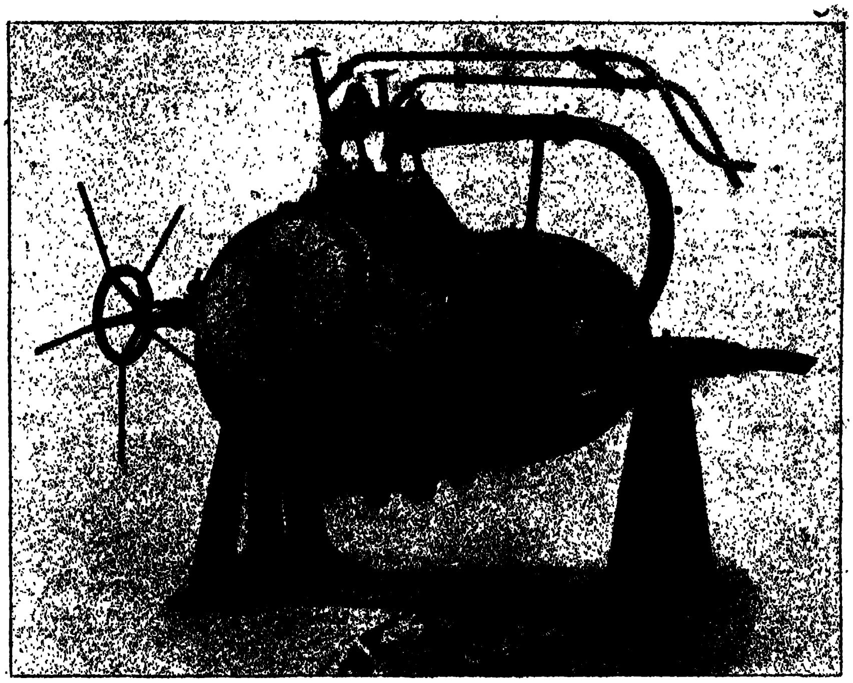
W. T. Howell, formerly with the Stewart-Warner Speedometer Corp., Beloit, Wis., has been made superintendent of the foundries operated by the Emerson-Brantingham Implement Co., Rockford, Ill.

A. Bigelow, formerly with the Metz Automobile Co., Waltham, Mass., has been made superintendent of the brass and aluminum foundry of the Rider-Bagg Co., Springfield, Mass.

The Philadelphia local committee of the American Foundrymen's association has issued an artistic multicolored poster announcing the annual convention and exhibition of the association to be held in Philadelphia Sept. 29-Oct. 3. The Liberty bell adorns the head of the poster. On one side of it is a locomotive and on the other side is a ship under construction, typifying two industries in which Philadelphia holds a prominent position.

New Oil-Fired Tilting Furnace Developed

A new type of oil-fired melting furnace has been developed by the Monometer Mfg. Co., Ltd., Birmingham, Eng. This furnace, which is shown in the accompanying illustration, was designed by Isaiah Hall, an English inventor and metallurgist, who is managing director of the company. The melting chamber is elliptical, and is mounted upon trunnions so that it may be rotated horizontally by gears actuated by a hand wheel. The burners are placed at the top as shown, and flexible hose connections to the feed lines permit freedom of movement in tilting. The internal measurement of the type shown is 2 x 3 x 6 feet, a size, which it is said, will melt from 1800 to 3000 pounds of metal to the charge. The cap bearings may be removed, the fuel and air line couplings disconnected and the entire furnace may be picked up by a crane and carried to any part of the foundry for pouring direct into the mold, if desired. This removable feature permits a spare melting chamber to be provided, to be used while another is being relined, thus avoiding interruption.



OIL-FIRED MELTING FURNACE

The proportion and pressure of both air and oil may be regulated independently to suit the conditions required. Temperatures in excess of 1800 degrees Cent. may be obtained, and it is said that the burners are so directed that a blanket flame is secured over the entire surface of the bath. The oil supply is delivered under gravity pressure, and an air pressure of from 2 to 5 pounds is required. Air pressure is controlled by hand valves at each burner. The flame may be cut off temporarily to allow inspection of the charge within. This inspection is further facilitated by the circular door at the front of the furnace, through which the products of combustion escape when the flame is on.

It is stated that this furnace may be used economically in the gray-iron plant as an accessory melting medium with the cupola, in steel foundries for melting alloys, and in nonferrous foundries for general melting purposes. The fuel cost per unit is a variable factor, depending upon the heat which it is necessary to develop with the different metals. It is stated that the lining is durable. The time required to melt a charge of pig iron is given from 45 minutes to an hour. An output of six tons per day of 10 hours is possible at this rate of melting.

This furnace is the latest product of the Monometer Mfg. Co., Ltd., which specializes in crucible and noncrucible melting furnaces, both of the tilting and stationary type, de-tinning, wire-tinning, cable-covering, and die-casting machines. The company anticipates the establishment of an American manufacturing branch to manufacture its line of products.

Captain Teixeira, a member of the Brazilian military commission, who recently spent several months in this country investigating steel plant and electric furnaces particularly, has placed an order through Fenwick Freres & Co., New York, for a Greaves Etchells electric furnace, manufactured by the Electric Furnace Construction Co., Finance building, Philadelphia.

The Norton Co., Worcester, Mass., has established a store at 73 West Congress street, Detroit, to handle grinding wheels and abrasive products used extensively in automobile manufacture. The store and service department of the new branch will be managed by C. W. Jinnette, who has been Detroit representative of the company for a number of years.

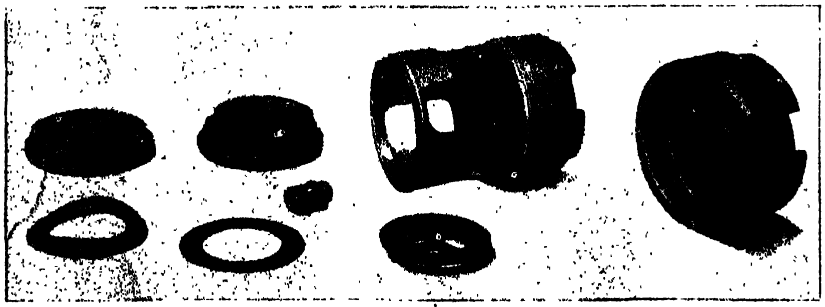
New Wafer Compressor Valves

The Sullivan Machinery Co., Chicago, is embodying a wafer air compressor valve as an improvement on everal of its single-stage steam and belt driven compressors. The small ize, light weight and compactness of he valve and its spring and seat are hown in the illustration below.

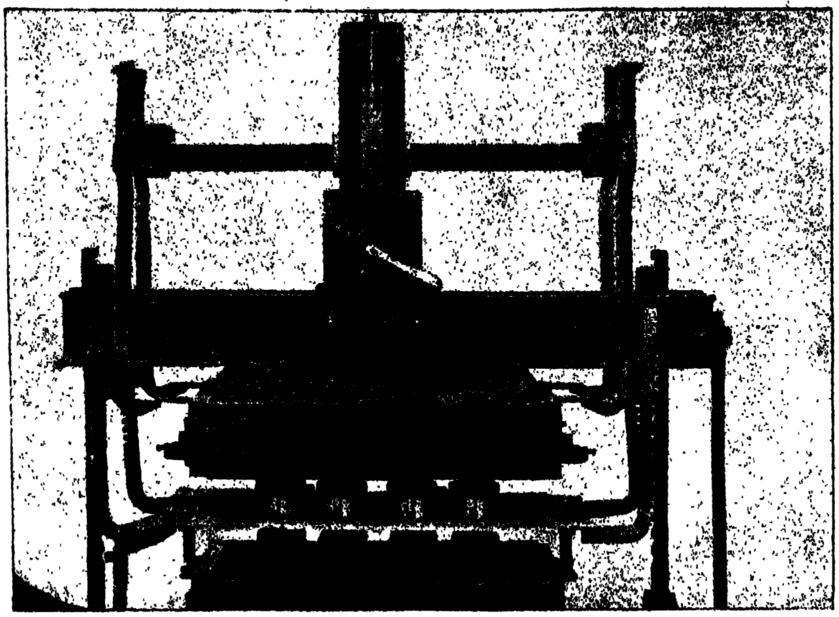
The wafer valves seat in cages aranged radialy to the axis, and close o the two ends of the cylinder, the nlet valve being at the bottom and he discharge valve at the top. The valves are held to their seats by flat nnular steel springs; they open against specially designed guard plates ntended to give a wide port opening with a minimum of clearance volume. The valve, spring and guard are ccessible by removal of a screw plug.

The short and simple construction of the springs permits the valves to be located quite close to the bore of he cylinder. The question of repair stock is simplified because the same valves, springs and guards are used for both inlet and discharge.

Compressors equipped with these valves are unloaded in the same manner as those having automatic poppet valves. There is an air pipe connection from the receiver which is controlled by a pilot valve at the side of the air cylinder. When the receiver pressure rises to the unloading limit the pilot valve admits air pressure through branch pipes to small plunger pistons located in the valve plugs The other end of the piston carries a three-pronged extension which raises the inlet valve from its seat until the receiver pressure falls the required amount, thereupon the plunger piston falls, the valve seats, and the compressor resumes its operation. While the valve is raised and the unloader in action, no air is compressed, the piston of the compressor simply carrying the air at atmospheric pressure through the cylinder and open valves.



WAFER COMPRESSOR VALVE PARTS



MOLDING MACHINE OF PLUNGER TYPE EQUIPPED WITH COPE-HANDLING AND PATTERN-DRAWING DEVICE SHOWING MOLD OPENED AND PATTERN READY FOR REMOVAL

Cope Lifting and Pattern Drawing Attachment

An improved form of cope handling and pattern drawing attachment has been placed on the market by the Foundry Appliance Co., Newark, N. J. It is stated it may be attached with a few set screws and the aid of a monkey wrench to any air squeezer of the plunger type. Conceived originally for handling deep, heavy copes, the application of the device has been extended to all sizes of flasks, including molds of the flat-back type. The cope is lifted and the pattern drawn mechanically. It is claimed that by its use production has been increased from 33 1-3 to 100 per cent, this increase being due to the elimination of all unnecessary labor. Furthermore it is claimed that its employment not only dispenses with 50 per cent of the labor but removes the necessity for molding skill on the part of the machine operator.

The device consists of two parts. The upper portion which performs the functions of cope lifting and pattern drawing, is mounted on the cross rail of the molding machine. Two vertical arms, one on either side, are suspended from a horizontal bar. This bar is in turn suspended from a counterweighted cable which passes over a sheave. Each of the arms is provided with two sets of lugs which intercept respectively, the cope and pattern plate as the plunger of the machine is lowered after the mold has been rammed. The arms are mounted on scale point bearings. This feature, in conjunction with the suspension of the entire upper portion of the device from a single cable, insures the proper alignment of the cope and pattern, irrespective of the position in which the mold is rammed. The use of scale point bearings also insures compensation for any irregularity on the flask.

The distance between the vertical arms may be increased or decreased to allow for any size of flask, and the elevations of the lugs may be adjusted at will. The vertical motion of the upper part of the device is governed by the position of the counterweight. This is set upon a slight incline and may be moved up and down by the molder as required.

The second of the two principal parts of the device is a movable table which is clamped to the molding machine table proper. It is mounted on rollers, making it possible to pull the drag forward in order to set cores after the mold has been opened.

Book Review

Abrasives and Abrasive Wheels, by Fred B. Jacobs; cloth, 340 pages, 5 x 8 inches; published by the Norman W. Henley Publishing Co., New York, and furnished by The Foundry for $3.

Abrasives and Abrasive Wheels contains valuable information for the ship or foundry superintendent and for the man who is engaged in the operation of grinding machinery of any kind.

The forepart of the book is devoted to natural and artificial abrasive materials such as emery, corundum, garnet, quartz, etc. Under the heading of artificial abrasives, the manufacture of carborundum and other well known manufactured abrasives is fully explained. The chapter on the manufacture of grinding wheels describes the lengthy process through which the material progresses until it is ready for shipment.

The testing of grinding wheels for efficiency is fully explained and illustrated by examples taken from actual working conditions. It is pointed out that by getting the right wheel in the right place, the manufacturer who is a large consumer can save thousands of dollars annually. In one chapter it is claimed that large wheels are more economical than small ones. The author has analyzed several popular sized wheels from a standard wheel list, determining the cubical contents and cost per cubic inch. It is shown that as the size increases the price decreases.

The subject of grinding wheel grits and grades, generally a confusing one to the average layman, is made plain. It is pointed out that grinding wheel manufacturers have never adopted a standard grade list and that such a procedure would save much confusion. With a view of hastening the adoption of a standard list, the author has included a table of standard grades of well known wheels, accurately compared. He explains how this list was prepared and comments upon its accuracy. A proposed standard grade scale is included in the chapter.

Other subjects treated include safeguarding grinding wheels, information for ordering grinding wheels, the design of dust collecting systems, etc. The latter part of the book is devoted to cylindrical, internal and surface grinding, cutter sharpening, etc. Several special grinding operations are fully described.

According to the researches of Leon Guillet and Victor Bernard of France, undertaken with a view of ascertaining if alloys having zinc as a base could be substituted for commercial copper base alloys such as brass and composition metal, an alloy containing zinc, 98 per cent, and aluminum, 2 per cent, appeared promising, but a better alloy is one containing zinc, 88 per cent; copper, 4 per cent, and aluminum, 8 per cent. These alloys were studied to ascertain their hardness, forging temperatures and resistance to shock.

What the Foundries Are Doing

Activities of the Iron, Steel and Brass Shops

A small addition will be erected by the Sacks Foundry, Newark, N. J.

A plant is being erected by the Marion Foundry Corp., Marion, Ind.

C. Bulups & Sons Co., Norfolk, Va., has awarded a contract for the erection of a foundry.

Erection of a modern foundry is being planned by the Rathbone Mfg. Co., Grand Rapids, Mich.

The Bunner Gas Range Co., South Bend, Ind., has increased its capital from $75,000 to $100,000.

An addition is being erected at the plant of the St. Marys Foundry Co., St. Marys, O.

A new foundry building is being erected by the Pacific Brass & Steel Foundry, Portland, Oreg.

The plant of the Beaulieu Foundry, Nicolet, Que., recently was damaged by fire.

A. F. Wendling has the contract to erect a foundry addition for Russell & Co., Massillon, O.

J. A. Sevigny, Nicolet, Que., plans to erect a modern foundry building.

The pattern shop of the Gardner General Foundry Co., Gardner, Mass., recently was damaged by fire.

Erection of a foundry is contemplated by the Willys-Morrow Co., Elmira, N. Y.

Plant additions, including a foundry, will be erected by the Robbins & Myers Co., Springfield, O.

Kaufman Bros., Ashland, O., plan the erection of a small foundry and office building, 45 x 70 feet.

A foundry and machine shop will be erected at Williamstown, N. J., by the Pusey & Jones Co.

Dick Bros., Inc., 20 Penn street, Reading, Pa., is reported contemplating the equipping of a foundry.

New plant additions which are being completed will make the melting capacity of the Saginaw Malleable Iron Co., Saginaw, Mich., 100 tons a day.

Due to increased business the Western Malleables Co., Beaver Dam, Wis., has found it necessary to reopen its South street foundry.

Burnett & Crampton, Rigaud, Que., are having plans prepared for the erection of a foundry to have a capacity of 250 tons of castings a month.

W. A. Moine, architect, is preparing plans for the erection of additions to the plant of the International Malleable Iron Co., Guelph, Ont.

Erection of an addition, 54 x 100 feet, is contemplated by the Riverside Foundry Co., Wrightsville, Pa.

Bids are being taken for the erection of two plant additions, 85 x 100 feet and 43 x 65 feet, for the Sun Ray Stove Co., Delaware, O.

Bids are being taken for the erection of a foundry, 100 x 220 feet, for the Parkersburg Rig & Reel Co., Parkersburg, W. Va.

The Baltimore Car & Foundry Co., Curtis Bay, Baltimore, is reported having purchased property adjoining its plant.

Plans are being drawn for the erection of a foundry addition, 90 x 90 feet, at the plant of the E. H. Bardes Range & Foundry Co., Cincinnati.

The capacity of the foundry of the Wausau Foundry & Machine Co., Wausau, Wis., will be increased.

An increase in capital stock from $60,000 to $79,000 has been authorized by the stockholders of the Aetna Steel Castings Co., Cleveland.

The Sommer Adams Co., 2934 East Fifty-fifth street, Cleveland, will make alterations to its foundry and machine shop.

The Des Moines Foundry & Machine Co., Des Moines, Iowa, recently organized, will build a plant. Emil Schmidt is president of the company.

L. C. Gahbert and others of St. Joseph, Mo., have organized a company and will erect a malleable plant.

The Warman Brass & Aluminum Co., Cincinnati, recently was incorporated with $25,000 capital, by Roy Warman and others.

The Blackmer Pump Co., Petosky, Mich., will enlarge its plant by the erection of a foundry and other buildings.

An increase in capital from $75,000 to $125,000 has been authorized by the stockholders of the Pettigrew Foundry Co., Harvey, Ill.

Capitalized at $50,000, the Lima Brass & Iron Foundry Co., Lima, O., recently was incorporated by Joseph White and others.

Erection of an addition, 130 x 800 feet, is contemplated by the Ross-Meehan Foundries, Chattanooga, Tenn.

The Moore-Noble Foundry Co., San Francisco, recently was incorporated with $12,000 capital, by J. H. Moore, E. B. Noble and others.

The M. L. Oberdorfer Brass Co., 804 East Water street, Syracuse, N. Y., plans the erection of a foundry addition.

A part of the plant of the Clarksville Foundry & Machine Shops, Clarksville, Tenn., recently was damaged by fire.

Announcement has been made of the sale of the property of the Van Wie Pump Co., including a foundry, to the United States Hoffman Co. The for-car company, whose offices are at Syracuse, N. Y., plans to erect a new foundry and machine shop as soon as a site can be purchased.

Charles Cunningham, Bristol, Va., is organizing a company with $50,000 capital, to engage in the manufacture of steel castings.

Gibbon & Sexton, founders, Chicago, have let a contract for the erection of a plant addition, 88 x 122 feet.

An increase in its capital from $20,000 to $125,000 has been authorized by the stockholders of the Wadsworth Aluminum Co., Wadsworth, O.

Erection of an addition to its pattern shop, 30 x 80 feet, is contemplated by the Royersford Foundry & Machine Co., Royersford, Pa.

The Columbia Brass Foundry, 722 High street, Los Angeles, has been organized by P. N. Bailey, C. E. Draper and others.

The Shilling Foundry Co., Columbus, O., is reported contemplating the erection of an addition to its plant. Clarence Shilling is president.

A permit has been taken out by the Collinwood Foundry Co., Cleveland, to erect a foundry addition, 25 x 42 feet.

John Dedler, proprietor of the Rhinelander Iron Works, Rhinelander, Wis., plans the erection of a new building for a molding department.

Steel & Radiation, Ltd., Toronto, Ont., is having plans drawn for the conversion of a factory building into a foundry.

The Ruff Malleable Iron Co., Detroit, plans the erection of a plant addition and chipping room, 144 x 232 feet.

Among the recent Ohio incorporations is that of the Sterling Foundry Co., Wellington, O. The company, which is capitalized at $150,000, was incorporated by R. E. Clisby and others.

Capitalized at $5000, the Kent Foundry Co. recently was incorporated at Grand Rapids, Mich., by Harm Enghors, William H. Duffy and Lewis E. Davis.

Frank L. Bridges and Peter Lamberius were named among the incorporators of the Acme Aluminum & Brass Works, Indianapolis, which was recently chartered with $40,000 capital.

Construction of a foundry, 100 x 150 feet, is being planned by the Great Falls Iron Works, Great Falls, Mont. Electrically operated cranes will be installed.

The Southern Pipe & Foundry Co., Knoxville, Tenn., recently was incorporated with $75,000 capital, by F. S. Mead, J. G. Simpson, T. S. Webb, R. W. Brown and Malcolm McDermott.

Incorporation papers have been filed with the secretary of state by the Ypsilanti Foundry Co., Ypsilanti, Mich., which was recently organized with $100,000 capital.

Additions being made to the plant of the Fulton Foundry & Machine Co., Cleveland, will increase its capacity 50 per cent. The extensions include a machine shop, 80 x 160 feet.

The Fate-Root-Heath Co., Plymouth, O., is erecting a foundry, 200 x 300 feet, and a power house and office building. All contracts for equipment have been let.

Erection of a reinforced concrete foundry building is being rushed to completion for the Keystone Foundry Co., Plymouth, Ind. J. E. Fogarty is president of the company.

The Jaeschke Bros. Foundry Co., Thirty-first and Locust streets, Milwaukee, will start work shortly on the erection of plant additions, including a foundry extension, 90 x 150 feet and a coreroom, 30 x 100 feet.

An increase of 100 per cent in the capacity of the A. E. Martin Foundry Co., 705 Park street, Milwaukee, is provided by plans for new construction which include a new core room and molding floor, 80 x 141 feet.

The South Beloit Stove & Mfg. Co., Beloit, Wis., recently was incorporated with $75,000 capital to take over the business of Charles H. Burgess & Son and engage in the manufacture of gray iron castings, stoves, etc.

The W. C. Hunt Mfg. Co., Ltd., Toronto, Ont., recently was incorporated with $10,000 capital to carry on business as iron and brass founders, by William C. Hunt, 59 Paton road, A. C. Crocker, 322 Symington avenue, and others.

Bids will be taken shortly by the Bridgeport Brass Co., Bridgeport, Conn., for the erection of a foundry.

Work on the erection of a $500,000 plant for the Adirondack Steel Foundries Corp., Colonie, N. Y., has been started.

John F. Henry, 320 Eighth avenue, Wilmington, Del., has plans for the erection of an addition to his foundry.

An addition now being erected at the plant of the Standard Brass Foundry Co., Cleveland, when completed, will house the offices, pattern storage, shipping and cleaning departments. The building now being used as a shipping department will be remodeled as an extension to the molding room.

The Great Lakes Malleable Co., Milwaukee, has awarded contracts for remodeling work and the erection of additions to its plant at 710-716 Reed street, formerly occupied by the Maynard Steel Foundry Co. The new work includes a building, 60 x 65 feet, to be used as an annealing shop. Ray F. Ethler is secretary.

Erection of plant extensions, which include a foundry, 180 x 300 feet, and an engineering building, 130 x 275 feet, has been started at the plant of the Kohler Co., Kohler, Wis.

Ground has been broken at Janesville, Wis., for a foundry for the production of tractor castings for the Samson Tractor Co., a division of the General Motors Corp. The foundry group will include coreroom, sand storage building and pattern shop and will cover an area 380 x 530 feet. Frank D. Chase, Inc., Chicago, is engineer in charge.

The Industrial Steel Casting Co., Toledo, representing a reorganization of the Taylor Coupler & Steel Castings Co., has started on the reconstruction of a building for its increased needs. When completed the work will provide space 120 x 180 feet in addition to the office. Four electric furnaces for producing steel for automobile castings, etc., will be installed. L. S. Dukes is president.

New Trade Publications

FOUNDRY EQUIPMENT—Pouring devices, molding machines, squeezers, and jolting machines are described and illustrated in a 4-page circular being distributed by the Arcade Mfg. Co., Freeport, Ill.

HOSE COUPLING—A newly designed hose coupling is described and illustrated in a folder prepared by the Independent Pneumatic Tool Co., Chicago. This coupling can be disconnected instantly by a straight pull on the knurled sliding sleeves. The bevel jaws and locking shoulders are heavy, with large bearing surfaces and according to the folder, cannot break, jar or work loose. The folder also describes a clamp, designed especially for hose couplings.

STEEL LUMBER—A reference handbook, which should be of especial use to engineers, architects, etc., for their use in designing various types of building construction, is being circulated by the National Pressed Steel Co., Massillon, O. The book is 72 pages in length and is cloth bound. The data given covers a system of construction in steel lumber with structural steel and other materials. Complete specifications of such construction, properties of steel lumber sections, tables of safe loads, construction details and other designing data are clearly illustrated and described.

FOUNDRY FLASKS—The Truscon Steel Co., Youngstown, O., is distributing a 4-page circular in which pressed steel foundry flasks are described and illustrated. The ribs and flanges of these flasks extend the full depth around the corners without buckling or cutting away the metal. The meeting joints are welded. The pinholders are of malleable iron and are securely riveted to the flask. The flange on the filling side is turned outward so as not to interfere with ramming the molding sand, or hold it when shaken out. The flange on the bottom is turned inward, holding the sand in place when the flask is lifted. One page of the folder describes and illustrates a steel platform for use with lift trucks.

PIPE CUTTER—The Fox Machine Co., Jackson, Mich., is circulating a 4-page folder in which it describes and illustrates its No. 10 pipe cutting machine. The base of the machine is of a cabinet type and contains a tank for the cutting compound, which has a capacity of 1½ gallons. The top of the machine is cast with flange around the outer edge and there are pads on the surface to which are bolted the brackets for supporting the various parts of the machine. The cutter arm is fulcrumed in heavy bearings, which also form the bearing for the main driving shaft. All gears are encased. Cutter disks are of tool steel, are 6 inches in diameter, and means are provided for grinding the disk while it is in cutting position in the machine. Three different sized pipe supports are furnished. The position of the cutter can be raised or lowered by turning a crank which extends through the front of the machine. A stop gage which is adjustable for cutting any length of pipe, forms part of the equipment.

PRODUCTION RECORDS—The Pelton Steel Co., Milwaukee, is circulating a 16-page booklet in which colored charts showing the production records of the company during 1916, 1917 and 1918 are given. One chart shows that during 1916 the company's average daily production was 2.34 tons and in 1918 the production had jumped to 11.72 tons. Another chart compares the number of shipments with the number of scrap tons returned. In 1916 there were 171.20 tons shipped while of this amount 5.83 tons or 1.24 per cent returned. In 1918 shipments totaled 3328.58 tons and of this amount 93.11 tons or 2.79 per cent were returned. Other charts given include, combination scrap record; electric furnace heat record and typical customers' shipments and returned scrap for the year 1918.

STEEL CASTINGS—A large cardboard-bound book of 62 pages, containing a pictorial portrayal of the plants at Attica, Ind., and Murphysboro, Ill., of the Harrison Steel Castings Co. and the National Car Coupler Co., and a brief description of their products, is being circulated. Printed on heavily coated stock and well illustrated, the book is a most attractive trade publication. A number of the illustrations are in color. The first part of the book is devoted to a brief history of steel; then follows the history of both companies. This is accompanied by views of the plant, including the interior of the pattern shop, the foundries, the open-hearth furnaces at the Attica plant, the laboratory and other departments. The latter part of the book is devoted to a description of castings made by the companies.

LOCOMOTIVE CRANE.—The United States Crane Co., Chicago, in bulletin 190, recently published, describes and illustrates its line of locomotive cranes, for grab-bucket, hook-block or magnet service. Some of the specifications of these cranes are: Working weight, 139,000 pounds; shipping weight, 120,000 pounds; ballast required, 30,000 pounds; lower frame: 18-inch I-beam with cast steel brackets for spur gear drive mechanism; rotation gear and roller path; rotation rollers; rotating frame; side housings; engines are of the vertical type, double, 10-inch cylinder diameter with 10-inch stroke; boilers of the vertical type, 54-inch diameter, 9½ feet high, 126 tubes, 2½ inches in diameter; steam pressure 125 pounds to the square inch; water tank capacity, 500 gallons and coal bunker capacity, 2000 pounds. The cranes have a drawbar pull of 9000 pounds maximum, a hoisting speed of 230 feet per minute and have lifting capacities, without track clamps or outriggers, of 20 tons at 15-foot radius and four tons at 50-foot radius.

The FOUNDRY

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Compressor Casting Takes 31 Cores

More Than Usual Care Was Necessary in Setting the Cores Accurately For Thickness on Account of the Heavy Air Pressure Which the Casting Must Withstand

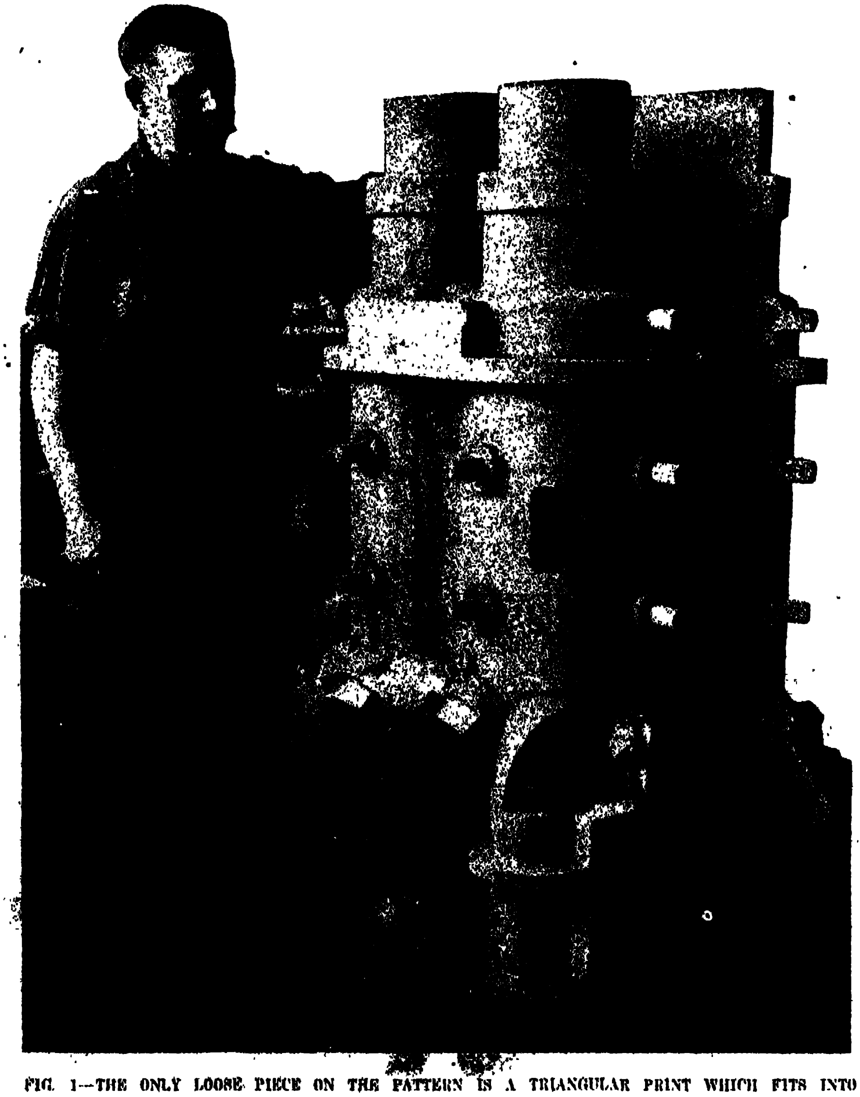

FIG. 1—THE ONLY LOOSE PIECE ON THE PATTERN IS A TRIANGULAR PRINT WHICH FITS INTO THE RECESS SHOWN. THIS PRINT LOCATES TWO BUTTONS WHICH ARE DRAWN AT A TANGENT

KNOWING the conditions under which a piece of machinery will have to operate a good engineer can usually design something to meet the requirements. When it comes to turning that design into something tangible, using some material substance which will answer the purpose intended, manufacturing difficulties frequently present themselves. These difficulties are sometimes of so serious a character that the design must either be amended or abandoned, but when that cannot be done the difficulties are only overcome by the exercise of the highest degree of skill, caution and judgment on the part of the manufacturer.

A problem of this character presented itself to the New London Ship & Engine Co., Groton, Conn., in connection with the construction of submarine engines. In this case the character of the design was rigidly limited and it was necessary, therefore, for the shop to meet the conditions laid down. The problem was encountered in its most acute form in connection with the construction of air compressors for fuel injection which are a necessary part of every diesel engine.

In an engine of standard type, the pressure in the cylinder at the time the fuel must be introduced, is about 400 pounds per square inch and this must not only be overcome by the pressure of the entering fuel, but it must be so far exceeded that the required quantity will pass into the cylinder in about one-sixteenth of a second Experience has shown that

FIG. 2 ALL THE SMALL CORE-PATTERNS ENTERING INTO THE CONSTRUCTION OF THE COMPRESSOR CASTING ARE STRUNG WIRES TO PREVENT LOSS

for this work an air pressure of approximately 1000 pounds per square inch is necessary at the spraying nozzle. To provide this air and at the same time keep the weight and size of the compressor within the smallest possible limits, a one-piece casting was designed and made successfully.

Although the molding and general methods employed in the foundry of the New London Ship & Engine Corp. to produce this compressor *en bloc* are in no way radically different from practice in many other plants, still the fact that exceptional care was necessary in every detail and the further consideration that 31 cores are used lends the operation considerable interest as a practical molding problem. During the initial work of preparing the patterns much doubt was expressed on the part of old time foundrymen as to the feasability of the job. Molders and patternmakers, alike, said the piece could not be successfully cast. One man, however, John W. Robertson, in charge of molding operations at the plant, had faith in the design. He entered into the job heart and soul until the conception was a reality In reducing this job to a practical manufacturing basis, a great deal of experimenting was necessary, but in this article only an outline of the method finally adopted can be presented.

Accuracy is Important

The patterns must be unusually accurate because an even thickness of wall is absolutely necessary for a working pressure of 1000 pounds per square inch. The main pattern for forming the mold is shown in Fig. 1. It is arranged for straight draft and the two halves are nearly identical Two lugs are located at about the center of the pattern, projecting radially at about 45 degrees to the line of draft If they were made part of the pattern it would of course be impossible to draw the whole piece without breaking away portions of the mold directly above the lugs; on the other hand if the lugs were made separate, in the form of buttons to be placed on the outside of the pattern it would be difficult to hold them to exact centers and also, being very small, they would easily be lost. To overcome this, the two lugs have been made part of a separate triangular block which fits into a recess in the pattern in such a way that the pattern itself may be drawn leaving the block with its buttons in place.

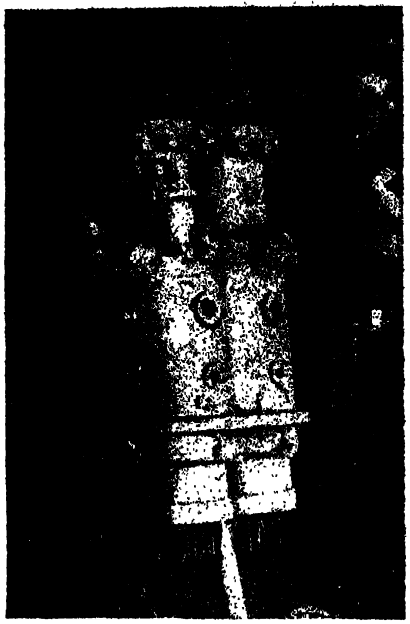

FIG. 4—THE CASTING AS FIRST TAKEN FROM THE MOLD BY THE CRANE WITH THE RODS STILL IN PLACE WEIGHS OVER 1600 POUNDS

This block, which is shown in Fig 1, may thus be drawn from the recess at the necessary angle to prevent breaking the mold.

After drawing the halves of this main pattern and finishing the mold, the various cores, one after another, are set in place. These cores are made up in advance in sufficient quantity to offset the possibility of breakage at the time of making the assembly. The core-patterns and all small pattern-pieces are drilled to receive a stringing wire as a means of preventing them from being lost Fig. 2 gives a good idea of the possibilities of saving time and avoiding the loss of small pieces by this method. It also conserves storage space

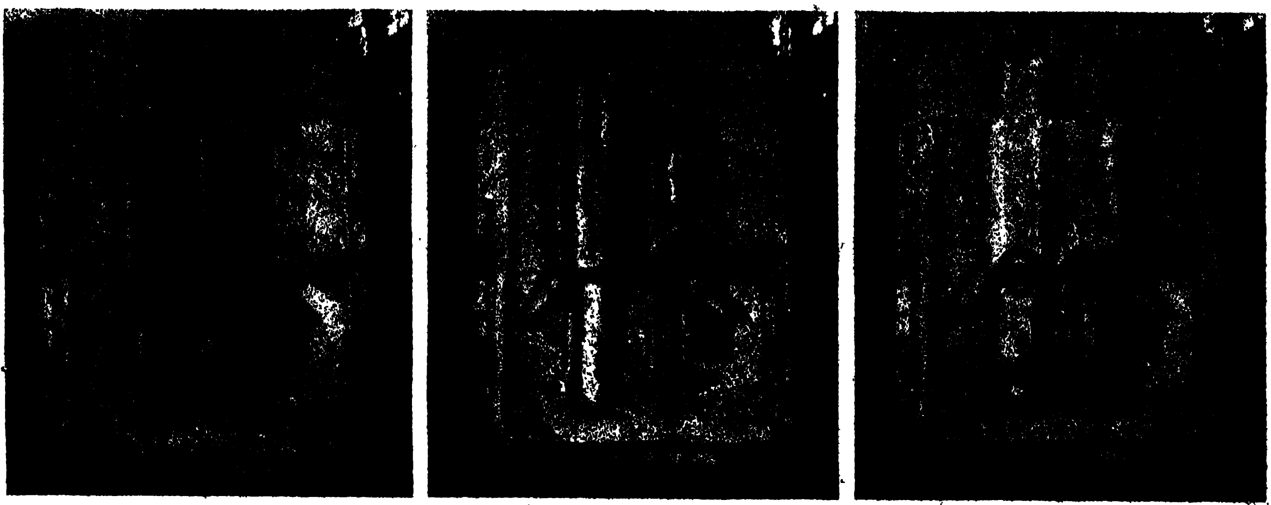

FIG. 3—THESE THREE VIEWS SHOW SUCCESSIVELY THE PLACING OF THE PRINCIPAL CORES. AT THE RIGHT, 31 CORES ARE IN PLACE IN THE DRAG READY FOR THE COPE

Some of the cores used are complicated and require unusual strength. The main water-jacket core is heavily reinforced and when completed is sufficiently rigid to permit somewhat rough treatment without breaking. This core is shown in place in Fig. 3. It is made up in two halves with projecting lugs at the parting. The reinforcing bars extend into these lugs which serve the double purpose of supporting the core and providing a purchase on the reinforcing wires for their extraction after the casting has been poured. The first or lower half of this core is laid in the mold and adjusted to correct position; then the cylinder cores, outlet cores, and other pieces are set in place and the upper half of the water jacket core is placed on top. It is wired to the lower half at the lugs which adds to the strength of the assembly and provides against slipping of one part over another. Finally the cope is lowered into place and the mold is ready to pour.

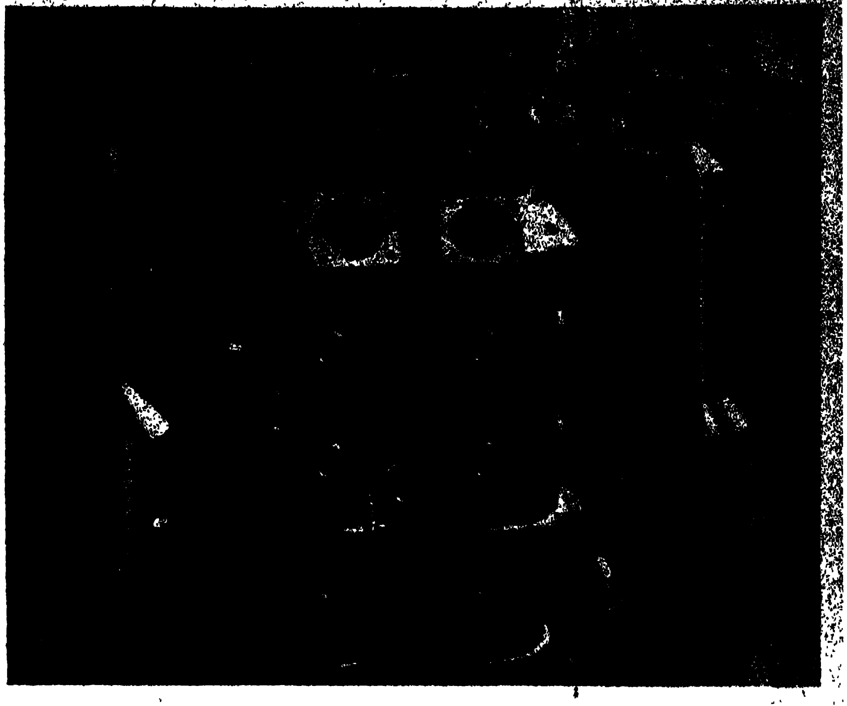

FIG. 5—THE CASTING WHEN COMPLETELY MACHINED BECOMES A THREE STAGE 1000-POUND PRESSURE AIR COMPRESSOR

The pouring is done from the bottom, that is, the gates are at that end of the mold which forms the bottom of the compressor. However, the mold is tipped up with the gates at the top when it is poured. The first portion of metal poured passes into the gate leading to the bottom of the mold (the top of the casting) and the second portion of metal goes through the central gate leading directly to the upper portion of the mold. This is accomplished by means of a pouring basin provided with three runners so arranged that the gate leading to the bottom of the mold may be filled first. The adjustment of many details has been necessary to make this pouring process completely satisfactory.

The metal at the bottom of the mold is under a static head of over 5 feet and some of the sand walls between different sections are only 5/8-inch thick. The casting, as poured, contains about 1600 pounds of iron and about 300 pounds of this are poured in through the gate leading to the bottom. In this way a sufficient quantity of hot metal is at the base of the mold to prevent spattering when the remainder of the metal passing through the central gates, drops in. The thin core walls are reinforced with strainer plates and many surfaces and corners of the mold proper are reinforced with nails and wires.

One important difference between this molding job and many others is the necessity of working to accurate dimensions. All fillets are down to size and the position of the cylinder cores is held to within exceedingly small limits. It can readily be seen

FIG. 6 IT IS A DIFFICULT TASK TO REMOVE ALL THE CORE WIRES. THIS IS DONE WITH SPECIAL HOOKS AND BARS

hat on account of the sloping suraces between high-pressure stage ortions of the cores and the larger ow-pressure portions, any longitudinal movement of these cores would mean variation in the thickness of the eparation walls.

When pouring first through the gate eading to the lower part of the mold, he metal drops 5 feet and several recautions are taken to reduce the endency to spatter and freeze. An lbow is placed in the path of the metal to check its downward velocity and a sullage riser is arranged at the bottom for the purpose of collecting any frozen particles occuring at the initial impact of the metal with the bottom of the drop. Any such impurities tend to be forced to the top of this riser, thus permitting the clean metal to pass directly into the mold through a side tap as shown in Fig. 3. After the pouring has been completed and the casting has cooled it is lifted from the mold by a crane and is transferred to a cleaning room where the cores and core wires are removed. Fig. 4 shows the casting just as it has been taken from the mold.

Core Wires Hard to Remove

Fig. 6 shows the method of removing core wires. It is important to get all these wires and all core sand out of the casting, for any foreign substance would tend to interfere with the circulation of the cooling water. Most of the reinforcing wires are pulled out through openings in the casting by means of pinch bars and other tools. As some of the wires are long and crooked this process is not always easy. Some of the smaller wires run straight from top to bottom and are obtained simply by fishing with a short hook through the holes. Such a hook with the wire which it has caught is shown in Fig. 6. After the removal of all the core material the casting is cleaned up in the usual way and sent to the machine shop.

A view of a completed set of cylinders made from this pattern is shown in Fig. 5 together with the two pistons. Inasmuch as this casting job has some features unique in foundry practice a few of the details concerning its production will be given. The sand used is made up of 33⅓ per cent Jersey molding sand, 33⅓ per cent floor or heap sand and 33⅓ per cent of Cape Cod sand. This latter is a sand found on the beach at Cape Cod. It takes the same shipping rate as common sand. The whole mixture is mulled up and while in the mulling machine is tempered with clay water. The mold is baked before pouring and becomes so hard that a barefoot man could step upon any part of it without causing injury. The iron mixture used is low in silicon and its composition is as follows:

	Per Cent
Silicon	1.33
Sulphur	0.075
Manganese	0.70
Phosphorus	0.30
Carbon	2.50

The castings must have a high ultimate strength and are not accepted unless the specimens test between 30,000 and 40,000 pounds tensile strength and between 3000 and 4000 pounds transverse strength. The cores are all bonded with linseed oil. The water jacket core is heavily reinforced. Each half has twelve ¼-inch wires running from top to bottom and equally spaced throughout their length; that is, they start from the narrow part at the top of the high pressure cylinders and spread in conformity with the general shape of the core where it surrounds the large cylinders. In each half of the core nine cross wires run from the lugs on one side to those on the other side, three being brought out at each lug. These wires spread apart as soon as they leave the lugs and together with the 12 longitudinal wires form a basket-like network. Where the wires cross they are fastened together with pieces of small wire.

Strict instructions are given that there shall be no filing or rubbing of the cores to correct defects. If the cores are not correct as they are made they are thrown out. The wires are covered with flour paste to insure a good bond with the sand. The work being very accurate, it takes one man eight hours to core up the mold; the mold itself requires two men eight hours for ramming and two men another eight hours for finishing. It takes one man eight hours to remove cores and core wires from the completed casting.

The entire job while at first treated with a great deal of caution, has now become part of the foundry routine. The amount of loss in the foundry is barely 10 per cent, and when the necessity for correctly placing 31 cores is considered, this is seen to be moderate.

Foundry Contract Let

C. W. Sherman, associated with the Dominion Steel Co., Hamilton, Ont., is president of the Adirondack Steel Foundries Corp., Colonie, N. Y., which has awarded a contract to the Crowell-Lundoff-Little Co., Cleveland, for a new $300,000 steel foundry.

New England Foundrymen Meet in Boston

The New England Foundrymen's association held its first fall meeting at the Exchange club, Boston, Wednesday, Sept. 10. A. O. Backert, president of the American Foundrymen's association, was the principal speaker of the evening, and his description of conditions in Europe was of special interest to New England manufacturers, nearly all of whom have export questions in mind. Mr. Backert, who has recently made an inspection tour through the iron and steel district of England, told of the sympathy between the nations.

To illustrate the size of some of the English industries, Mr. Backert pointed out that one plant which he visited, turned out 25,000 tons of malleable iron per year. In many plants he found idle electric furnaces. The reason for this being that the extremely high price of electric power has made it impossible to continue the operation of these furnaces which were put in during the period of production frenzy, brought about by the war. Converters are used freely and a common installation includes a cupola mounted high enough so that metal flows by gravity directly into the converter. Mr. Backert stated that even now, under the crippled condition of Germany, with the whole Alsace-Lorraine district in French hands, that country still is second in pig iron production.

The franc, normally worth less than the German mark, now has a purchasing value in Germany of about three times its prewar value. In other words, for twenty cents in French money something over 60 cents worth of German goods can be purchased and how ever strong may be the sentiment against buying from Germany, it can hardly be expected to overcome the great advantage obtained through the difference in exchange.

Organize New Company

The Vibrating Machinery Co., capitalized at $50,000, has been organized and chartered at Chicago, and has taken over the entire business of the Schroeter Engineering Co., establishing a plant and office at 546 West Jackson boulevard. Julius Schroeter is president of the new concern, F. Von Schlagell is treasurer and Mrs. J. C. Miller, secretary. The company manufactures an oscillating foundry riddle and a gas unit for welding and cutting. The latter device is just being put on the market and is designed to use natural or city gas in connection with oxygen.

Experts Discuss Pulverized Coal

Design of Burner and Kind of Coal Used are Important—Economy Shown in Annealing Malleable and Tests With Powdered Coal on the Air Furnace are Recorded

FOR a number of years powdered coal has been used successfully for firing malleable-iron annealing furnaces, and recently a number of foundries have equipped their melting furnaces with apparatus for burning this type of fuel. While the data obtained so far have been too meager to warrant definite conclusions, the introduction of powdered coal into malleable-iron melting furnaces is without doubt being closely watched by producers in the hope of finding a means of dispensing with some of the labor required for the ordinary system of coal firing. For this reason the symposium of papers on the use of powdered coal presented at the annual meeting of the American Foundrymen's association in Philadelphia Oct. 1 is of special interest. Papers were presented by Charles Longenecker, the Bonnot Co., Canton, O.; A. J. Grindle, Combustion Economy Corp., Chicago, and Milton W. Arrowood, Ground Coal Engineering Co., Chicago. Mr. Longenecker gives data on an installation of powdered coal burning equipment on malleable-iron annealing furnaces which shows a cost of $2625 when using powdered coal, against $4900 for doing the same amount of annealing with natural gas and $8400 when using fuel oil. At another foundry a saving of 48 per cent has been effected in the quantity of coal consumed when it was used in the powdered form. The question of melting malleable iron in the air furnace with powdered coal is taken up by Mr. Arrowood. This question is not solely one of cost, but involves the effect of the flame and the ash from the coal on the metal and on the brickwork of the furnace. Not enough data have so far been secured to warrant definite conclusions but much information on the subject has been added by Mr. Arrowood's paper. That steel is being melted with 450 to 600 pounds of powdered coal per ton of charge and that 15 malleable foundries using powdered coal for annealing have a fuel ratio of from 500 to 700 pounds of coal per ton of castings is shown by Mr. Grindle. He also gives analyses of different coals which have proved satisfactory for use in the powdered form

Develop Firing System For Air Furnace

BY MILTON W. ARROWOOD

VOLATILE pulverized fuel is highly combustible when dry, and if injected into a furnace at ignition temperature will ultimately burn as it finds air. But it is not believed that the highest efficiency is possible except where the greatest care is taken to introduce the air and fuel into the furnace as a completely diffused mixture. All problems calling for rapid and wide diffusion, whether it be a bursting hand grenade or the mere breaking up of a dust body call for action from the inside out.

A burner which has been designed to develop action of this kind is shown in Fig. 1. The powdered coal is fed by a screw feed into a perforated drum, *B*. Here it is met by a current of air blowing down on it from the pipe, *A*. The air and coal mix in this drum and are further mixed as they pass through the perforations and strike the walls of the encasing chamber, *C*. From this chamber they pass through the pipe, *D*, into the main chamber of the burner, which contains two or more sets of mixing shells concentrically arranged. In this chamber the main body of air is introduced through the conductor, *E*.

Having this type of apparatus, arrangements were made to conduct a series of tests on an air furnace at a plant in Meadville, Pa. Owing to some misunderstanding as to the method to be used in controlling the top blast, the original burner installed was designed to admit half the air at the top blast and take the remainder through the burner. This sacrificed at least half the mixing efficiency of the apparatus. A 14-inch duplex burner was used, capable of taking air enough for mixing and burning 1200 to 1500 pounds of coal per hour and a proportionately greater amount according to the amount of air admitted at the top blast. Pulverized coal was purchased from an outside plant, being that used ordinarily for annealing. It analyzed as follows:

	Per cent
Sulphur	1.34
Volatile matter	35.32
Fixed carbon	50.80
Ash	12 45
Moisture	1.43

Air was supplied by a No. 7 Sturtevant fan at a pressure on the fan outlet of five ounces, the line running some 40 feet to a Y-division supplying the two parts of the burner. The existing branch of the line supplying air to the ash pit was not disturbed. The burner was first lit with the furnace empty, the total air pressure at the burner being 8 inches and at the overhead blast pipe 4.25 ounces (difference due to pipe layout). The furnace was operated on this basis for 2 hours 12 minutes, the average coal fed being about one ton per hour.

At 1 hour and 20 minutes from starting time, a pig of iron was placed in the rear side door of the furnace and another in the front door. These were dripping freely in eight minutes. When feeding the full amount of coal, combustion was not complete until the flame came in contact with the top blast just over the bridge wall. Thus the principal heat zone was too far in the rear of the furnace. Coal was *filled into the hopper* by hand *from* bags of known weights, the amount of coal left at end of run being deducted. It was found that the feed screw had been delivering 0.3 pound per turn. The furnace was built for a charge of 10 to 12 tons.

The following day, a 2-ton charge made up of pig iron, hard scrap and railway malleable, showing an average of 0.914 per cent silicon and 0.627 per cent manganese was put in the furnace, which was then fired, without skimming bath, for 3 hours and 29 minutes, when the iron was poured, the fire being continued for 15 minutes while tapping out. A total of 5914 pounds of coal was used, or say three tons of coal for two tons of iron. The general character

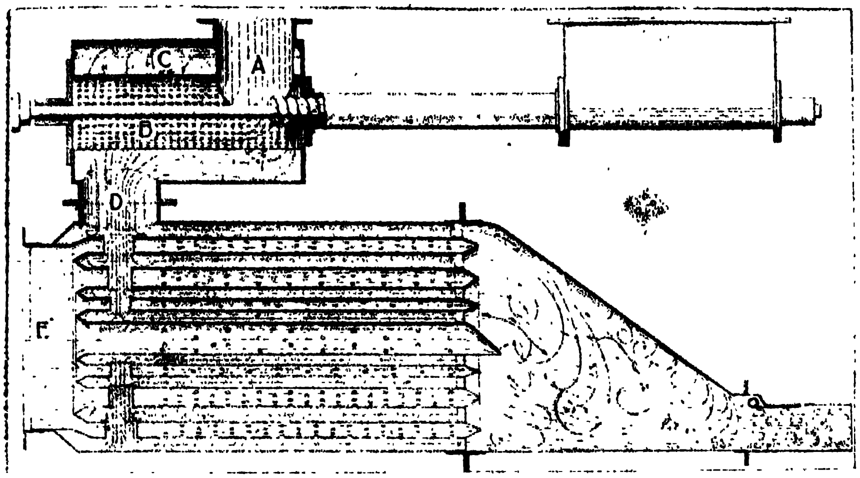

FIG. 1 BURNER DESIGNED TO THOROUGHLY MIX POWDERED COAL WITH THE AIR WHICH BURNS IT

of the metal was satisfactory but it was necessary to leave considerable slag in the furnace, owing to the condition of the bottom and the tap holes.

The brick covering that had been placed over the grates was removed at the bridge wall across the fire box for a space 1 foot wide lengthwise of the furnace. This made it possible to admit air through the ash pit under the fire in regulated amount. A 4 ton charge showing 0.902 per cent silicon and 0.62 per cent manganese was charged on the following day and on starting the fire it was at once seen that the large volume of air rising at the bridge wall deflected the flame to the roof and formed a cold blanket on the bath, thus making a slow heating furnace. The rear bridge wall had been built up two courses of brick and after running one and a half hours it was decided the fire was choked too much. Twelve minutes were lost in removing some of the brick, after which the fire was continued for a total of 5 hours and 52 minutes, including a short shut down to replace bung. The roof showed distress while the bath showed dull, attributed to the air condition above mentioned. Owing to the short charge it was not possible to skim the heat effectively, although it was partially skimmed after four hours. The total coal consumption was 10,300 pounds or 5.1 tons for four tons of iron melted in a 12-ton furnace. A test bar poured at 4 hours and 40 minutes showed silicon, 0.54 per cent, sulphur 0.102 per cent, phosphorous, 0.131 per cent, and combined carbon 3.50 per cent.

The opening over the grates was filled up and the eight 2-inch tuyeres on top blast were changed to 3-inch, the floor of combustion chamber was filled up to within 10 inches of top of front bridge wall. The outer end of the burner was raised and the discharge pointed at a downward angle against the front end of the charge. The burner was then lighted on the empty furnace for 1 hour and 15 minutes, it being desired to start a charge with a hot furnace. A 5 ton charge of the same composition as the previous heat was then fired for 4 hours and 55 minutes, with shut down of 5 minutes on account of the loss of a bung. The total coal fed was 9088 pounds or an average of 1725 pounds per hour, or a total of 4.5 tons for 5 tons of iron in a 12-ton furnace, with a considerable amount of slag left in the furnace from previous heats that could not be skimmed properly. The quantity of metal was sufficient to permit fair skimming and at 3 hours and 30 minutes a considerable amount of slag of good appearance was skimmed off. At 4 hours and 10 minutes a test bar showed 0.73 per cent silicon and 0.098 per cent sulphur, while a second bar poured at tapping out 4 hours and 40 minutes from starting showed as follows:

	Per cent
Total carbon	3.20
Combined carbon	2.78
Graphitic carbon	0.42
Manganese	0.30
Phosphorous	0.155
Silicon	0.98
Sulphur	0.06

A test bar poured from a ladle taken off during tapping out showed 0.68 per cent silicon, 0.081 per cent sulphur and a tensile strength of 35,600 pounds. Another analysis from pig, taken in same way, showed as follows from a different chemist:

	Per cent
Silicon	0.67
Sulphur	0.048
Manganese	0.44
Combined carbon	1.55
Graphitic carbon	1.20

Analysis of iron from hand fired furnaces in the same plant showed as follows:

	Per cent
Silicon	0.59
Sulphur	0.092
Phosphorous	0.150
Manganese	0.26
Combined carbon	2.97
Total carbon	2.98

As a result of this test, it was conclusively shown that all of the air should be admitted through the burner and arrangements were then made to set up a burner of sufficient capacity for this purpose. At the time of preparing this paper for presentation reports on additional heats have not become available. It is hoped that further data will be available later.

A 30-inch burner has been installed on a furnace, built for a capacity of 10 to 15 tons in a prominent foundry in Erie Pa. A view of the burner attached to this furnace is shown in Fig. 2. Acting on the idea of having the initial com-

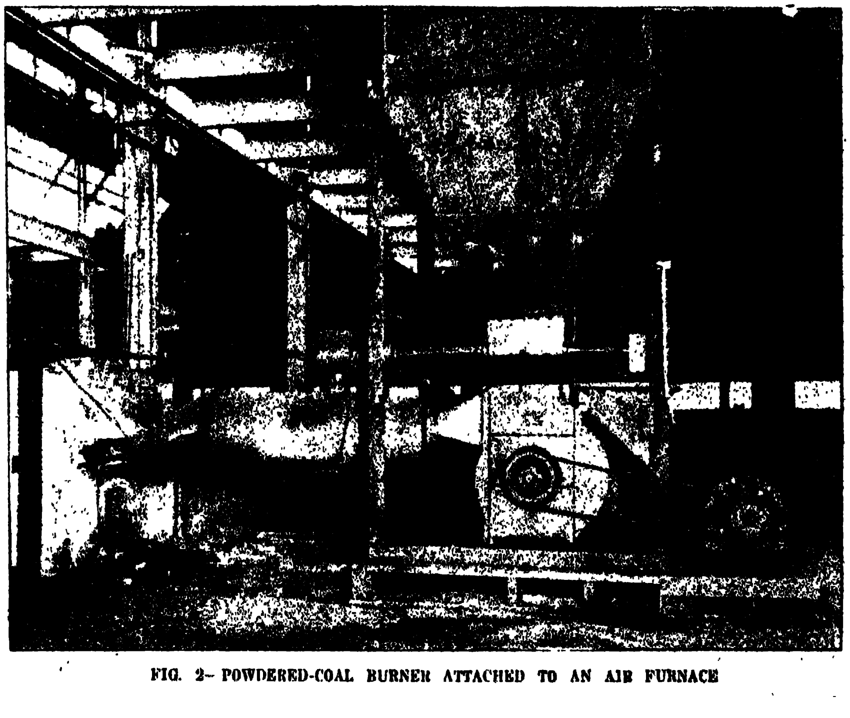

FIG. 2—POWDERED-COAL BURNER ATTACHED TO AN AIR FURNACE

bustion occur on the front end of the charge, the combustion chamber was made only about 2 feet in length from the noze of burner to the front bridge wall. For reasons noted, this proved to be unsatisfactory and it was considered desirable to lengthen the combustion chamber about 7 feet, thus completing combustion by the time the gases reach the bridge wall so that the extremely hot gases come in contact with the charge.

This lengthening of the furnace, together with other minor changes and adjustments, as well as insufficient mill capacity to supply coal for full time operation, and the fact that the conveying system from the mill to furnace hopper has not been installed, caused delay in placing the furnace in regular operation. It is contemplated to put this unit in daily service as soon as circumstances permit.

In malleable iron annealing, the powdered-coal burner performs functions equally as satisfactorily as in the air melting furnace. For greatest economy in the use of pulverized coal, the ovens should be of comparatively large size. It then becomes a problem of uniform heat distribution and control so as not to burn the pots. With some types of pulverized coal burners it is found that the heat is thrown in too great degree toward the front end of the ovens. At times the poor heat distribution with high velocity burners results in burning top pots near the burner, while the bottom ones on the same stools may not be annealed. Where a cutting flame cuts down the brick on the firebox, the destruction of pots near the burner may be aggravated from slag deposition and fluxing. At other times, if the coal happens to be a little damp or not ground as fine as usual, some of it may be deposited on the floor and blanket the bottom pots near the burner.

While no commercial installation has yet been made on the muffle type of annealing oven, a number of test runs were made on such an oven handling railway castings. In a plant having 26 ovens of a capacity about 25 tons each, the practice with hand firing was to secure one pound of castings annealed per pound of coal. An improved form of oven was constructed and on a specially conducted test showed a ratio of 2.2 to 1. A 6-inch powdered coal burner on the same oven showed a ratio of 5.2 to 1 and the test record of flue temperature (presently to be mentioned) indicated that the length of this oven could be increased 6 feet without using any more coal, in which case the ratio would be 7.25 to 1. The difference between 1 pound of castings and 7.25 pounds per pound of coal is shown to be very great. On this basis 14 ovens will do the work of 12 and there is a capital saving of $24,000 besides space released for several molding floors, etc.

The total time of firing, however, was 49.5 hours as compared to the usual hand firing period of 90 to 110 hours on the same ovens. The special hand-fired test showing ratio of 2.2 to 1 was made in 72 hours firing time. The total coal consumption on this run was 9650 pounds and 25 tons of castings were annealed, making the ratio 5.18 to 1. The castings were of excellent quality.

Powdered Coal for the Small Foundry

BY A. J. GRINDLE

THE use of powdered coal for fuel has interested foundrymen, manufacturers and engineers for over 100 years, but until the last few years its practicability has been doubted by most engineers owing to the great number of failures which have been made in its preparation and burning.

In malleable and steel foundries using 10 tons of coal per day, or its equivalent in oil, gas or coke, the use of powdered coal for fuel is practical in the opinion of the author. There are several open-hearth furnaces now using this fuel; steel is being melted with 450 to 600 pounds of coal per ton of charge. There are about 15 malleable foundries using powdered coal for annealing, the fuel ratio on these ovens being from 500 to 700 pounds of coal per ton of castings; much time is being saved in bringing the ovens up to annealing temperature. Malleable iron has been melted with 31.2 per cent coal to iron, a 12-ton heat being melted in three hours and 40 minutes with a ton more scrap than usual in place of pig iron.

Steam boilers are being fired with powdered coal and 8½ to 11 pounds of water per pound of coal are being evaporated. If a foundry is equipped with a powdered coal plant it is practical to fire the core ovens with this fuel.

In addition to the fuel saving and savings effected in decreased oxidation of the metal, I believe a saving of 25 per cent to 75 per cent in labor can be made. A uniform temperature can be maintained and therefore a uniform product. Core ovens and steam boilers can be equipped with a thermostatic control and the heat controlled as easily as with gas.

Heretofore the small foundry could not use powdered coal for annealing owing to the high cost of an installation compared with the possible savings, but now it is practical for even the small foundry, since it can be used in all departments where fuel is consumed.

Feeding and Burning Coal

No matter how well coal is dried and pulverized, proper combustion cannot be secured without a uniform feed of coal, thorough carburization with air, and means of easily and accurately controlling the coal and air supply. Equipment has been perfected which overcomes many of these difficulties.

Powdered coal has a tendency to pack in the storage hopper, especially when it stands a few days before burning, and if the opening in the hopper bottom is too small the coal will arch over the feed screw and stop the fuel supply. This trouble has been corrected by a specially designed feed screw enclosed in a cast-iron hopper bottom with a large top opening. This feed worm will feed throughout its full length. The coal gradually loosens up toward the discharge end in place of packing. At the discharge end there is a revolving disk which breaks up any packing of coal which might take place along the feed screw. Packing causes an unsteady feed of coal and a pulsating flame, but it is believed this system eliminates this fault and produces a uniform feed, resulting in a steady continuous flame.

Coals best suited for burning in a powdered form are those rich in volatile matter, such as bituminous and semi-bituminous, either slack or run-of-mine. The slack has an advantage over the run-of-mine as it is not necessary to crush the former before drying.

The following analysis represents a coal which has been found to give good results on melting furnaces:

	Per cent
Fixed carbon	60.12
Volatile matter	35.80
Ash	3.08
Moisture	1.00
Sulphur	.38
B.t.u.	14,050

Good results have been obtained in annealing ovens and steam boilers from coal of the following analysis:

	Per cent
Fixed carbon	53.20
Volatile matter	29.00
Ash	16.34
Moisture	1.40
Sulphur	1.80
B.t.u.	12,600

Qualities of anthracite lignite and peat, as well as the inferior grades such as anthracite culm, dust and slush, and bituminous and lignite slack screenings and dust are all suitable for burning in pulverized form, for certain kinds of work, when dried and properly mixed with a higher volatile fuel. For the proper igniting and burning of powdered coal the volatile content should be 20 per cent or more, while the quality of the fuel is an important consideration the conditions under which it is burned are more so.

The cost of preparing powdered coal for burning runs from $0.46 to $1.00 per ton depending on the amount pulverized. The cost of an installation runs from $18,000 to $150,000 according to the capacity and number of the furnaces to be fired.

Using Pulverized Coal for Annealing

BY CHARLES LONGENECKER

THE first installation of powdered coal burning apparatus on malleable iron annealing furnaces was at the plant of the Erie Malleable Co., Erie, Pa., where B. J. Walker adopted this method of heating in 1896. Since that time numerous other installations have been erected. The Pressed Steel Car Co., Pittsburgh, formerly the Pennsylvania Malleable Co., made its initial application of powdered coal to annealing furnaces in the fall of 1917, and since then these furnaces have been in continuous operation. In this plant each air furace is practically all below the floor level. There are 10 large and 18 small furnaces, some of which are used for annealing steel castings. The larger ones have a capacity of 50 tons, while the smaller hold 25 tons. Fig. 1 shows a longitudinal cross section of the large furnace and Fig. 2 a transverse section.

As is well known, the requisites in an annealing furnace from a thermal standpoint are a uniform temperature (and consequently heat) throughout the heating chamber and the maintenance of a constant degree of heat for the proper length of time. To secure these conditions, it was necessary to install four burners in each furnace and maintain a steady flow of coal to these burners. The following table shows a typical run and illustrates how well conditions have been met:

July		
10	Noon, furnace lighted.	
11	1600° (6 A. M.)	1630° (6 P. M.)
12	1640° (6 A. M.)	1620° (6 P. M.)
13	1620° (6 A. M.)	1600° (6 P. M.)
14	1640° (6 A. M.)	1620° (6 P. M.)
15	1620° (6 A. M.)	1640° (6 P. M.)
15-16	1630° (9 P. M.)	1640° (3 A. M.)
16	1620° (6 A. M.)	

From the foregoing we obtain the following summary:

Furnace lighted, July 10, noon.

Time to bring furnace to temperature 1600 degrees, 18 hours.

Furnace held at temperature, 1000 degrees, 120 hours.

Firing discontinued, 6 a. m., July 16.

Bungs (roof) removed, 6 a. m., July 18.

The castings were then removed as soon as they were cool enough to handle.

A pyrometer is inserted in each end of each furnace. Each one is connected to a central instrument. It is the duty of the furnace attendant to read the temperature of each furnace at frequent intervals on this instrument, so that there is little chance for any wide fluctuation in temperature. One attendant supervises all the furnaces.

With powdered coal it requires from 14 to 18 hours to bring the furnace to 1600 degrees, with fuel oil the time is 22 to 24 hours, and with natural gas about 26 hours. From the foregoing it seems apparent that powdered coal gives results which are thermally satisfactory.

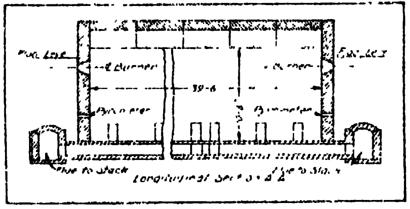

FIG. 1--LONGITUDINAL SECTION THROUGH ANNEALING FURNACE AT A-A, FIG. 2

There is an accumulation of fine ash which must be removed from these furnaces at intervals. The length of these intervals will depend on the percentage of ash in the coal. When the coal has a low ash content the accumulation is removed once a month. In the standard type of furnace, where the heating chamber floor level is at general floor level, the disposal of ash is of small moment, due to greater accessibility of both heating chamber and flues.

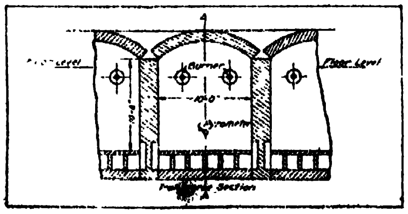

FIG. 2--TRANSVERSE SECTION THROUGH ANNEALING FURNACE

As is well known, in annealing malleable castings a fluctuating temperature must be avoided and at no time is it permissible to allow the temperature to fall below the critical range. To secure this control of the heat requires close regulation of both the fuel and the air to burn it. No trouble has been encountered in holding these conditions constant.

A comparative record of costs for three fuels is as follows:

Natural gas, 14,000,000 cubic feet at 35c per 1000, $4900; fuel oil, 105,000 gallons at 8c, $8400; powdered coal, 525 tons at $5 per ton, $2625.

The figure $5 given as the cost of powdered coal includes besides the coal all labor, power, etc. These costs are taken from actual practice and cover three separate months during each of which one of these fuels was burned.

In another malleable iron foundry where powdered coal is now burned in the annealing furnaces, a saving of 48 per cent has been effected in the quantity of fuel consumed. In this case the amount of powdered coal burned per ton of output is 450 pounds. The time to bring the furnace to temperature has been reduced from 24 to 36 hours, required for hand firing, to 11 to 14 hours. When hand fired, there was always a difference in temperature in these furnaces of from 200 to 300 degrees between the front and rear. Today, when fired with powdered coal, this temperature appears to be uniform. This is accounted for by the fact that the pressure in the furnace is equalized, as it is impossible to obtain a uniform temperature throughout the chamber unless the furnace is under a slight pressure. With stack draft and hand firing it is exceedingly difficult to avoid pulling in some cold air, especially at the door. This makes a cold streak and naturally it is impossible to secure a uniform temperature under such conditions.

Besides malleable castings, the Pressed Steel Car Co. also manufactures steel castings. They are annealed in the same furnace as the malleable castings. The temperature carried when annealing steel is 1660 degrees Fahr. One of these furnaces was lighted at 3 p. m., July 15, and firing discontinued at 11 a. m., July 16, so that the total time required for the annealing was 20 hours. The coal consumption was 140 pounds per hour.

Fig. 3 shows the tops of the furnaces and the pipes through which the coal and air are delivered to the burners. The large spiral riveted pipe on top carries the coal, while the secondary air flows through the lower one. Two-inch wrought iron pipes branch from these. The latter are connected at their upper ends to the control valves, shown in the illustration, which regulate the flow of coal and air to the burners. Their lower ends terminate at the burner.

The coal which passes through the upper pipe is of course very fine, as it must be held in suspension throughout the length of the pipe. The principle of distribution is as follows:

The coal is received in cars and after being dried is pulverized and then conveyed pneumatically to a substation at the foundry building. Here it is separated from the high pressure air and falls into a 25-ton bin. Two spiral screws feed the coal from this bin into a pipe connected to the suction side of the fan. This fan has a capacity of 6000 cubic feet of air per minute. In the fan the fine coal is mixed with air in the proportion of 1 pound of coal to 60 cubic feet of air. This mixture is then forced through the pipes and delivered to the burners as desired by the furnace attendant. As is well known, it requires at least 200 cubic feet of air to form a combustible mixture with one pound of coal that is burned.

There is, therefore, no danger of combustion until the necessary additional 140 cubic feet has been added at the burner. The ratio of 1 pound of coal to 60 cubic feet of air is maintained automatically by a very simple electrical contrivance. If desired, the ratio can be changed and the machinery set to hold it constant.

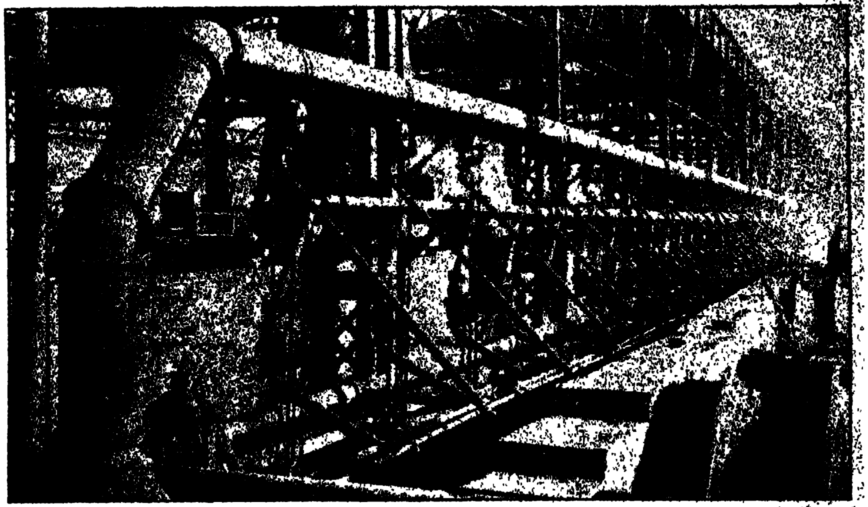

FIG. 3—VIEW ALONG TOPS OF ANNEALING FURNACES SHOWING PIPES FOR CARRYING AIR AND POWDERED COAL

The Globe Foundry Co., Sheboygan, Wis., recently has been incorporated by G. F. Honold, Gus A. De Wilde Jr. and Fred Leicht. The new company will take over the Globe Co., and will extend its facilities by the construction of a new gray iron foundry. The present foundry will be converted into a machine shop to handle general machinery manufacture.

Why Facing is Necessary

Foundry facings are applied to the surface of molds for the purpose of preventing adhesion between the metal and the sand of which the mold is composed. When the facing performs this function properly, a casting is secured which requires little or no cleaning, thus effecting a great saving in the operating expenses.

The saving is not confined to the item of cleaning, but also appears in the reduced cost of machining due to the absence of burnt sand on the surface of the casting. When facings of the better quality are used, the castings are of that fine bluish gray color so much desired by the progressive foundryman.

The reason why a graphite or *silver lead* facing prevents the sand adhering to the metal is as follows:

Graphite is one of the forms of carbon and is a combustible material. When molten metal is poured into the mold, the air in the mold and the air carried in by the stream of melted metal furnish oxygen enough to bring about a certain amount of combustion, forming a gas between the metal and the mold. This effectually prevents adhesion of the metal to the sand, and just as long as the gas film exists no adhesion can possibly occur.

Pure graphite will not adhere of itself to the mold surfaces, but will run before the metal the moment the sand dries. To prevent this, it is necessary to add a binder to hold it in place. The proper proportioning and selection of this binder is a matter of the utmost importance. Facings with a large percentage of binder are more difficult to slick than those with a low percentage. Therefore they are indicated where the sand is used quite dry. It is common experience that facings used during the summer months with the utmost satisfaction, are found fault with when winter months come, because they don't slick well. This is most often experienced in foundries which are not well heated and which become unusually damp in cold weather. The sand does not dry out so rapidly as in the summer, and is consequently just a little damper when used. This accounts for a difference in the working of the facing.

There are four general classes of work that require different facings: Green sand, loam, dry sand and cores.

Green sand molding is by far the most common, and is used for nearly all iron molding done in flasks. *Green sand* means damp sand that can be packed sufficiently hard to retain its shape. Facings are dusted on, and slicked by hand.

Dry sand molding differs from green sand in that after the mold is finished, the flasks are placed in a drying oven and thoroughly dried. Facing for dry sand is mixed with water and applied to the hard surfaces as a wash.

Core work. If the casting is to be hollow, a core of the proper form is suspended in the mold, so that after metal is poured the core can be knocked out and leave a hole of any desired shape within the casting. Cores are commonly made of flinty sand mixed with some kind of binder and baked hard. They are then coated with a graphite wash, the same as for dry sand work.

Good castings depend largely upon good facings, or at least good castings are impossible with poor facings. On the other hand, it is necessary that the facing be available at a reasonable cost consistent with quality.

Machining Qualities of Malleable

Cutting and Drilling Tests Were Made on Malleable Iron Samples With Different Physical Properties to Determine Relation of High Elongation and Tensile Strength to the Machinability of the Metal

BY EDWIN K. SMITH AND WILLIAM BARR

DURING the past year or so, there has been considerable discussion of the machining qualities of malleable castings. At the same time there has been a decided tendency toward raising the physical characteristics, especially the tensile strength and elongation. This naturally has brought up the question: "What effects have the higher physical properties had on machinability?" There are wide differences of opinion in regard to this, and as the subject is of importance to manufacturers, as well as to users of castings, it seemed advisable to collect the available data, in order to present at least a preliminary report at this time. On getting in touch with various foundries, it became evident that there are two general opinions, and that practically every concern has a strong leaning toward one or the other of these opinions.

Opinions Differ

One set maintains that machinability is practically independent of physical characteristics, and that castings showing high tensile strength and elongation machine quite as well as those with lower physical properties The other group feels equally strongly that in certain lines of work, where extremely high strength is not necessary, greater ease and speed of machining can be obtained by using a metal with lower physical characteristics. There is no question as to what metal to make when great strength is the one essential requisite.

There is little literature on this subject. A paper presented at the American Foundrymen's association convention in Boston in 1917 recommends the manufacture of malleable with high characteristics, but admits that with such extra good material, the user may have to increase the strength of his machine tools, and decrease the cutting speed.

Another noted authority wrote: "In looking over these records, it is only fair to consider, that included in them are bars from concerns in which high strength and ductility have been sacrificed, in order to secure such a character of metal, as would machine with the greatest ease, this property in these particular cases being the predominating requirement." Also "One thing is certain, that as in the case of steel, the malleable iron casting that machines most kindly, is as a rule, the one poorest in physical properties."

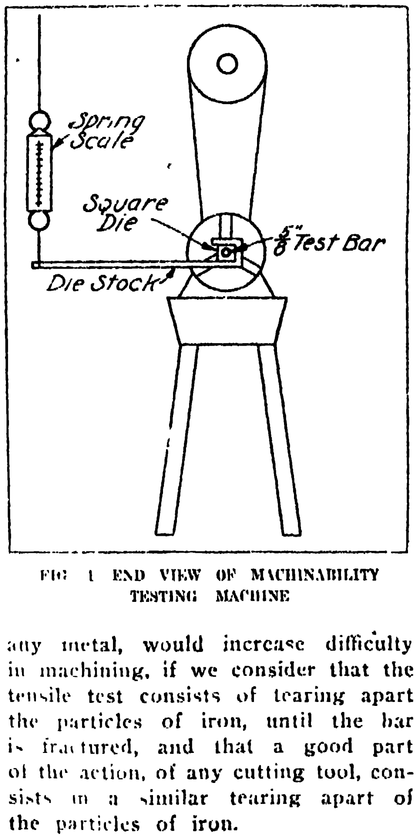

FIG. 1 END VIEW OF MACHINABILITY TESTING MACHINE

Theoretically it would seem probable that a high tensile strength in any metal, would increase difficulty in machining, if we consider that the tensile test consists of tearing apart the particles of iron, until the bar is fractured, and that a good part of the action, of any cutting tool, consists in a similar tearing apart of the particles of iron.

In order to obtain the ideas of those whose experience would qualify them as judges, we wrote a number of malleable foundries, and the replies showed considerable difference of opinions. A few quotations will suffice:

1—"Very high tensile strength and high elongation malleable machines quite well."

2—"Iron of 50,000 or 55,000 pounds tensile strength, with elongation 12 to 16 per cent is easily machined; 100 per cent of this iron is machined at high speed—without the least trouble."

3—"There is no question but that very high tensile malleable iron will not answer for the small castings on which a great deal of finishing is done—where the quantity finished per hour is a matter of prime importance. High tensile material is a necessity for car work."

4—"Unless we were able to do this (vary our mixture) our tool cost for machining these castings would in some cases be enormously increased."

It is rather significant that the product of manufacturers of light castings, especially those extensively machined, as a rule, averages considerably lower in physical tests, than that of makers of heavy castings, although both classes of castings give excellent results under actual service conditions.

The Test of Practice

It is particularly noticeable that the majority of concerns which both make and machine certain lines of small castings, prefer a metal of medium low test, as they find that the strength of this metal is ample, and machining qualities superior.

In view of the foregoing opinions, it seems obvious that there is need of some definite method for determining a machinability figure. It has been amply demonstrated that none of the methods for determining "hardness" gives any idea of machinability of malleable castings.

As by far the greatest part of the difficulty with high speed machining has been with the threading operations, we have endeavored to devise an apparatus to give a machinability figure, based on threading. We simply used an engine lathe, as indicated in Fig. 1. The pieces first tested were the standard $\frac{5}{8}$-inch tensile strength bars, with one end sawed off. The remaining large end was held in the chuck. A standard die was held in a stock, and was forced on the $\frac{5}{8}$-inch end of the test bar. To one end of the die stock was attached a rather accurate spring scale. When the chuck was revolved, a $\frac{5}{8}$-inch thread was cut on the bar, and the pull required to cut this thread was of course registered on the scale. Giving the scale readings it is of course simple to calculate the actual pull on the die in cutting.

Samples were obtained to cover the range of 42,000 to 52,000 pounds tensile strength per square inch. Table I gives results of the first series.

A paper presented by Edwin K. Smith and William Barr at the annual convention of the American Foundrymen's association held in Philadelphia Sept. 29 to Oct. 3.

Table I

Results of First Machine Test

No.	Decarb. Depth	Tensile Strength	Elas. Limit	Elongation Per Cent	Lbs. Actual
8	0	40560	33333	7.0	791
1		47680	36220	7.0	813
N5.15-6	1/64	48000	35330	9.5	843
22		48295	34500	9.0	870
121		49190		12.0	952
N5.13-5	2/64	51870	37330	18.0	933
31425	4/64	46620	34380	7.5	970
U	3/64	50650	34950	11.5	1221
16		54320		10.0	1302

Table II

Second Machine Test

No.	Decarb Depth	Tensile Strength	Elas. Limit	Elongation Per Cent	Lbs. Actual
31418	3/64	41870	31000	7.0	625
3159	7/64	42810	31400	7.0	772
3164	5/64	40300	31710	6.0	808
31414	1/64	50120	35140	7.5	898
31526	2/64	43500	30870	7.0	[illegible]
31512		46870	31000	9.0	952
Gray Iron Bar		27370	27370	0.0	9,9
Cast Steel		51950	38210	10.0	1034
Gray Iron Plate					1077
31513	4/64	43720	32610	8.0	1104
3165	3/64	44210	33150	7.0	1137
Soft Steel					1493
Hard Steel					1676

Table III

Machine Test on Larger Bars

No.	Tensile Strength	Elastic Limit	Elong. Per Cent	Lbs Actual
Gray Iron	27370	27370	0.0	1220
-1°	45740	33140	7.5	1291
1-6°	42610	32000	9.5	1310
X2-3°	41110	36690	6.0	1310
N 5.15 6	48900	35330	9.5	1334
2 8°	42060	31030	9.0	1369
1X-4°	43750	36410	7.0	1428
3X-2°	44680	34520	7.5	1453
U	50650	34950	11.5	1495
C	46550	30260	11.5	1537
N-5.13-5	51870	37330	18.0	1537
Cast Steel	51950	38210	10.0	1598

Table IV

Results of Drilling Test

No.	Decarb. Depth	Tensile Strength	Elas. Limit	Elong. Per Cent	Time Min. and Sec	Inches Drilled	Inches Per Min.
Gray Iron Slab					3-2.0	.7559	.249
3-31425-	1/64	46620	34380	7.5	3-9.0	.7559	.240
4-31415-	3/64				3-9 1	.7559	.239
2xx-5-15-6N	1/64	48000	35330	9.5	3-11.0	.7489	.235
2-	7/64				3-16.9	.7559	.231
2x-3165-	3/64	44210	33150	7.0	3 20.5	.7011	.230
7-3149-	4/64				3-21.5	.7716	.230
4x-3159-	2/64	43500	30870	7.0	3-23.5	.7077	.226
5 3159-	7/64	42840	31400	7.0	3-26.0	.7755	.226
6 3151-	2/64				3-22.2	.7508	.225
1x-31513-	4/64	43720	32610	8.0	3-30 6	.7705	.222
5x-3164-	5/64				3-28.2	.7677	.221
3x 31515	4/64	45480	33580	7.5	3-28.2	.7637	.220
1xx-5-13-5 N	2/64	51870	37330	18.0	3-25 0	.7489	.219
8-31414	1/64	50120	35140	7.5	3-20.9	.7637	.218
5xx-8	0	40560			3-31 2	.7519	.214
1-31418	3/64	41870	31000	7.0	3 34 2	.7598	.213
4xx-C	3/64	46550	30260	11.5	3-36 0	.7519	.209
Gray Iron Bar		27370	27370	0.0	3-55 6	.7077	.180
3xx U	3/64	50650	34950	11.6	4-37 4	.8340	.181
Steel Soft					8-45 1	.7480	.085
Steel Cast		54950	38210	10 0	13-11.4	.7559	.055
Steel Hard					11 2.2	.7322	.052

The column in Tables I, II and IV marked "Decarb" gives the depth to which the carbon was burned out in the anneal. From these preliminary experiments, the authors were not able to find any relation between depth of decarbonized rim, and machinability.

The speed was 27 revolutions per minute; die, U. S. Standard ⅝-inch.

These bars were all very nearly ⅝-inch diameter, and were very free from any irregularities of surface. The results are arranged according to the ease of machining, and it will be noted that generally speaking, the ease of machining decreases with increasing physical characteristics.

Thinking that possibly the small differences in diameter might affect results, we next selected a series of similar bars, and machined each to exactly ⅝-inch. These were threaded results being shown in Table II; speed 27 revolutions per minute; die U. S. Standard ⅝-inch.

In order to vary conditions, we next prepared castings with 1-inch diameter, and repeated the test, using a U. S. standard 1-inch die, speed 14 revolutions per minute. The surface of the castings was not machined before threading.

Drilling Tests

While these results, which are given in Table III, show very great variations, it is obvious that on the whole, ease of machining is sacrificed to higher physical characteristics.

It seemed possible that a drilling test might throw some light on the subject, so we fitted a vertical drill press, as shown in Fig. 2. A 50-pound weight was fastened on top of the spindle, the combined weight being 65 pounds. The spindle being thrown out of feed gear, we thus had a constant pressure on the drills, all of which were 15/64-inch in diameter. The speed was 206 revolutions per minute. The results are shown in Table IV. Time to drill through ¾-inch bar was determined by stop watch.

Although we have a wide variation in physical figures, we are unable to see any relation between these and speed of drilling.

One point which came up in this test, and which probably has some effect on difficulty in threading high tensile, high elongation iron, was that produced by the length of chip cut. The approximate length of chip made by cutting tool is given in the following table:

No.	Tensile Strength	Elongation Per Cent	Length of Chip, Inches
C	46550	11.5	3/8
5 15-6-N	48000	9 5	2
5.13-5-N	51870	18.0	5
U	50650	11.5	6

Obviously the longer the chip, the more trouble will be caused in threading, especially on the return operation, while with any ordinary cutting work, the long chip will do no harm.

While the results of all the foregoing tests are suggestive, it is obvious that in order to be in anyway conclusive, they must be repeated, under better conditions, and we believe that a very much faster feed would give better results. As our equipment is not suited for high speed on this work, we wrote the University of Wisconsin, and have recently received a letter, stating that the mechanical engineering department would be glad to run conclusive tests on this subject in the fall. They are especially well equipped for such work, and if it can be arranged, we should get conclusiv figures from their tests.

From the foregoing experiment and from all data available to u we can venture the followin opinions:

First—At medium speeds, all prop erly manufactured malleable casting can readily be machined, whethe such castings are of low or of moder ately high physical characteristics.

Second.—Where speed of machin ing is of greater importance tha great strength, a metal of say 42,00 pounds tensile strength, and 6 per cent elongation will give the best results.

To our minds, a very interesting point was brought up by results on machining bars of various kinds of steel and gray iron, as shown in tables II, III and IV. Of course too much cannot be judged from a test on a few samples, but from the figures shown we notice that the following results hold through the series of tests:

First.—The malleable bars machine approximately as easily as the gray iron.

Second.—The malleable has almost double the strength of gray iron and an elongation of about 8 per cent as compared to no elongation in the gray iron.

Third.—Malleable castings can easily be supplied to equal this grade of cast steel in all physical tests, and to surpass it so far as smooth surface is concerned. And at the same time the malleable castings will show a superior machinability according to the operation, ranging up to that shown in the drilling test where repeated tests on cast steel showed that it required about four times as long to machine cast steel as malleable of similar physical properties and characteristics as nearly as a comparison might be drawn.

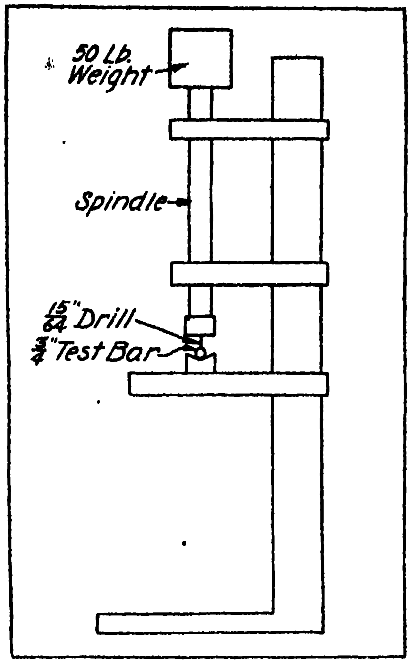

FIG 2—APPARATUS FOR DRILLING TEST

Hard Spots in Castings

By H. E. Diller

Question:—Small castings, under a pound in weight, which we make, frequently have hard, white spots around the edges. The analysis of our iron averages: Silicon, 3.22 per cent; sulphur, 0.050 per cent; phosphorus, 0.74 per cent; manganese, 0.87 per cent. We would like to know the cause.

Answer:—The hard, white spots at the edges of your castings were probably caused by wet sand which chilled the metal at the places which were white. In a similar case it was found that the molder was swabbing the corners of the molds with water to prevent the edges from breaking.

High silicon irons such as you are melting are particularly subject to chilling under these circumstances. We would recommend that you run the silicon in your metal between 2.25 and 2.50 per cent and guard against moisture

Elimination of Strains in Castings

BY C. J. WILTSHIRE

IT IS a well known fact that appreciable strains which are caused by unequal radiation of heat from the castings after they are poured remain in iron castings after cooling. This unequal radiation is due to variation of section and difference in length of paths through which the heat must pass to escape from inner to outer surfaces. In consequence the heat is not uniformly dissipated. The portions where the metal is thickest and also those most remote from the point of heat exit, retain their temperature longest, and as result, shrinkage strains are set up in the parts which cooled first.

Some 22 years ago, Alexander Outerbridge, of Philadelphia, discovered that vibration of a cast iron bar (by tumbling in a barrel or by a continued tapping with a hammer) would invariably increase the strength of the casting. The theory of this treatment is that the action of cooling causes molecules of iron to be held in tension which is relieved when the casting is subjected to vibration.

It has since been found that this tension can be relieved by annealing the castings in an oven of moderate temperature. It is the purpose of this paper to describe the method.

That shrinkage strains exist in most castings is demonstrated by the fact that if a plain cast-iron plate be machined to a true surface on one side, the operation of machining the other side will frequently disturb the accuracy of the surface first finished. This phase of the matter was presented to the American Foundrymen's association in a paper on "The Seasoning of Gray-Iron Castings," by L. M. Sherwin, of Brown & Sharpe Mfg. Co., at the Boston meeting in 1917, and later published in the October, 1917 issue of THE FOUNDRY.

Large castings which have been left in the sand to cool off slowly and then finished to true dimension, have been found distorted under ordinary temperature changes, after a few days, but these same castings after treatment in the oven did not show any change whatever.

Other castings which have been finished and put under steam for test have shown considerable distortion when taken apart, while castings from same patterns when treated in an oven before finishing and tested out in the same way, showed no change.

Again, large castings which have been finished and lined up as parts of a large unit, have shown sufficient distortion to cause parts of the machine to become out of line after a number of months in service. Such castings are now being annealed and from results obtained it is believed that this treatment will prevent the defects experienced.

The method of treatment is as follows:

The castings are placed in the oven, the doors are closed, the heat turned on, and the temperature raised to 700 degrees Fahr., which generally takes from seven to eight hours. This temperature is held for an additional seven hours, when the heat is shut off and oven is allowed to cool down slowly for approximately 20 hours, with a resulting temperature of about 300 degrees Fahr. The oven doors are then opened and temperature is allowed to drop to approximately 150 degrees Fahr., when the castings are in shape to be taken out. The entire operation consumes about 48 hours.

The ovens are heated with oil and the amount of oil per ton of castings treated has averaged 9.6 gallons. Each heat required 284 gallons of oil and approximately 29 tons of castings were treated each heat.

A paper presented at the Philadelphia meeting of the American Foundrymen's association, Sept. 29-Oct. 3. The author, C. J. Wiltshire, is foundry superintendent, General Electric Co., Schenectady, N. Y.

Sulphur Reduced in Malleable Iron

Cupola Metal Refined in the Electric Furnace—Sulphur is Lowered by a Reducing Slag Containing Calcium Carbide—Advantages of Such a Duplexing Process are Considered

BY A. W. MERRICK

THE American or blackheart malleable cast iron produced in this country is usually melted in air (or reverberatory) open-hearth or cupola furnaces. Either of these types of furnaces offer certain inherent advantages and disadvantages, but as it is with the last named that we are to deal in this paper, the discussion will be limited to this one method of melting.

Its advantages are briefly as follows: Low initial investment; low cost of operation, upkeep and repairs; intermittent or continuous operation which gives a great flexibility of capacity; high melting ratio of iron to fuel, and ability to melt high percentages of cast iron and steel scrap without the consequent lowering of the carbon content which would necessarily follow in either of the other two types of furnaces. From the foregoing it will be seen that the cupola will produce molten cast-iron at the spout cheaper than any other type of furnace, and this fact is universally conceded by all authorities.

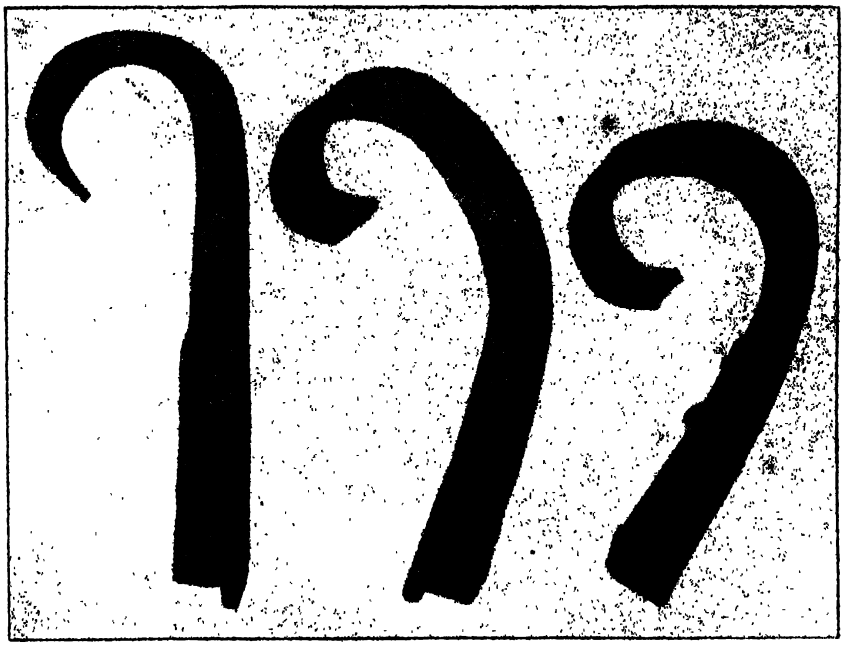
FIG. 1—RESULTS OBTAINED WITH TEST WEDGES OF LOW MANGANESE IRON

There are, however, certain disadvantages in cupola melting as applied to cast iron in general and malleable cast iron in particular. First, the sulphur absorbed from fuel is higher with this process than either of the others. Secondly, it is not possible to produce an iron of a low carbon content, which with malleable iron limits one to the production of casting of very light section. This is due to the fact that the melting stock, being in intimate contact with the incandescent carbon of the fuel, absorbs carbon so readily, that with the constant silicon aimed for in malleable iron, a practically saturated condition is reached so that with other conditions equal, the carbon is never very far either above or below a fixed point. This holds good even where the percentage of steel in the charge is varied considerably. Thirdly, cupola iron, especially on long heats, is liable to quite a variation in temperature and composition. The latter evil is especially aggravating in malleable work where the importance of keeping the two elements sulphur and manganese, in a proper relationship is well recognized.

In order to overcome these last two disadvantages we might utilize some sort of a mixer that would act as a reservoir and by holding a given quantity of metal allow it to become constant in temperature and composition. The difficulty with this plan, is of course, that the temperature of the molten metal would be constantly lowering unless some external source of heat were applied, so that the question narrows itself down to just what this source of heat would be. The electric furnace, at once suggests itself as ideal, for in addition to supplying the heat needed, it will also allow the removal of the greater part of the sulphur by use of a proper slag. Not only this, but it will, in addition, allow an iron of any carbon content to be made by the means of additions of either cold or liquid steel, so that compositions of any range of carbon and silicon can be made and any castings of sections practicable in malleable iron may be poured. The advantages of such a duplex process are readily apparent to anyone familiar with the production of cupola malleable iron. Cupola iron is especially suitable for castings of light section such as pipe fittings, etc. In the latter case where an iron high in carbon is desirable, because of the greater ease of threading the fittings this process should recommend itself immediately. In addition to the advantages previously enumerated it would permit the annealing of the white iron at a considerably lower temperature than is practicable with a high sulphur iron, such as is ordinarily produced in the cupola.

In order to determine how far it is possible to reduce the sulphur in cupola iron in a reasonable length of time by this process, some sprues and scrap were obtained from a manufacturer of cupola malleable iron and melted in a small Heroult electric furnace. The material had the following composition: Silicon, 0.65 per cent manganese, 0.53 per cent; phosphorus 0.143 per cent; sulphur, 0.20 per cent and carbon, 3.06 per cent. This analysis was supplied by the firm which furnished the scrap and was given as the average. No attempt

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Paper presented by A. W. Merrick at the annual convention of the American Foundrymen's association held in Philadelphia, Sept. 29-Oct. 3.

The author is metallurgical engineer in the research laboratory of the General Electric Co., Schenectady, N. Y.

was made to check it due to the difficulty of securing an average sample of material of this nature.

The scrap was melted bare in the furnace and then a basic slag of lime thinned with spar was put on. Finely ground petroleum coke was sprinkled over the slag to reduce all oxides throwing the metals back into the bath. the slag turning a creamy white color, indicating the completeness of these reactions. Calcium carbide is formed in the slag as is evidenced by the pronounced odor of acetylene when such a slag is moistened in water. A slag of this character will readily absorb sulphur from the bath and while the reactions require some time for completion, the practical elimination of the sulphur is very rapid.

Accordingly, 15 minutes after the slag was made a sample was taken for analysis, with the following results: Silicon, 0.57 per cent; manganese, 0.54 per cent; sulphur, 0.057 per cent; and carbon, 3.36 per cent. Note the reduction of sulphur which is very striking when it is considered that the sample was taken just 15 minutes after the formation of the slag. There is something further of note, namely the retention of the manganese. This element is readily oxidized in the cupola and it is customary to run the mixtures very high in manganese to take care of what is burnt out in melting and still leave enough for the high sulphur that is obtained. With the electric furnace, no speigeleisen, ferromanganese, or high manganese pig is necessary, and in fact, as will be later shown, the mixtures, to get best results, would have to be kept low in this element. As was mentioned before, the analysis before melting was supposed to represent the average so that the slight difference of silicon obtained need not be considered. The carbon, however, seems to have increased, but there is a possibility of doubt here, as 3.06 per cent seems rather low for cupola iron in the first place. Then again, when carrying a refining slag on low carbon steel, which is greedy for carbon, the increase due to additions of coke to the slag are so small as to be negligible.

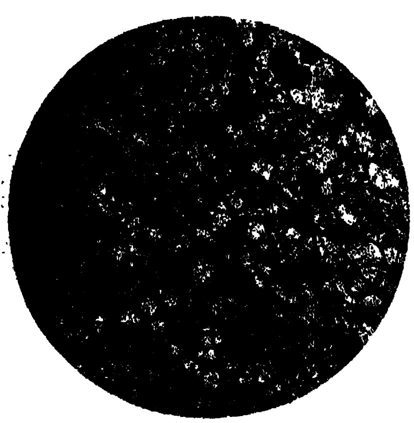
FIG. 2 STRUCTURE OF CENTER OF TEST BAR

At the same time the sample was poured for analysis, a set of test bars was poured and after cooling the bars were broken and fractures examined. The bar ⅝-inch in diameter was clear white and the 1¼-inch bar nicely mottled so that the composition seemed all right for the class of material under consideration. A set of test bars and wedges for annealing was then poured.

In order to obtain iron more suitable for work of a heavier section, some steel and ferrosilicon in calculated amounts were added to the bath. The calculation was based on the 3.08 per cent of carbon as supposed to have been in the original material but as it was actually higher in carbon the result was higher than desired. However, it was near enough for the purpose, to illustrate the possibility of producing an iron of a lower carbon than is ordinarily obtained in the cupola. The actual analysis is given as follows: Silicon, 0.75 per cent; manganese, 0.53 per cent; sulphur, 0.036 per cent; and carbon, 2.90 per cent.

Slag Lowers Sulphur

It is interesting to note in passing that the analysis obtained was exactly that expected, taking into consideration the actual first analysis, and the analysis and amounts of the additions. Anyone who has had experience in adding ferrosilicon to an air furnace where a strongly oxidizing condition prevails, to bring up the silicon, can appreciate this. The sulphur is still lower in this sample, which can be attributed to the further refining of the slag, for even had the steel contained no sulphur the resultant would have only been 0.045 per cent, had the slag not absorbed more from the bath.

Test bars of this composition were poured and both sets of bars were subsequently sent to the firm that supplied the scrap for annealing. They were packed in the second pot from the bottom and placed in about the middle of the oven.

The examination of the bars after annealing showed that the metal was inclined to be rather "short" and that it lacked toughness. This might easily be expected when the high manganese, low sulphur composition is taken into consideration. The fractures viewed with the eye looked like typical blackheart iron with the exception that the rim of ferrite is heavier than usual. Under the microscope, however, we find that the structure consists of a rim of ferrite and the interior a matrix of ferrite and pearlite embedded with temper carbon, instead of a pure ferrite matrix, characteristic of good blackheart iron.

As it was impossible to obtain any low manganese, high sulphur cupola iron without making it especially for our purpose, a mixture of gray scrap, washed metal and steel was melted to give a composition approximately that obtained by refining a cupola iron high in sulphur but low in manganese. Bars were cast from this heat as previously and annealed. The composition was similar to the first lot prepared except that the manganese was 0.14 per cent and the sulphur 0.009 per cent. In this case where the sulphur was low to start with, it had practically been eliminated by the action of the slag in the furnace.

These bars after annealing were quite a lot better than those first prepared, containing manganese over 0.50 per cent. The test wedges could be curled up more, as is shown in Fig. 1. The tensile strength of this composition is from 38,000 to 40,000 pounds, but the elongation in 2 inches is only 3.5 per cent. The molding was bad and these were very defective looking bars. The bars when polished and etched, showed an improved structure over the first set but still showed some pearlite in the rim, although the center of the bar showed the typical blackheart structure. This is shown in the photo micrographs, Figs. 2 and 3.

FIG. 3 STRUCTURE OF RIM OF TEST BAR

The conclusion to be drawn from this result is that evidently there is still too great an excess of manganese present for the low sulphur and some further work is planned to verify this.

Among the conclusions which the author arrived at are the following:

1—The cupola is the cheapest method for producing molten cast iron.

but the process has several inherent disadvantages that have limited the use of cupola malleable to work of light sections. It produces iron high in sulphur, and variable temperature and composition.

2—The electric furnace is capable of refining this iron, reducing the sulphur to a negligible amount and superheating the metal to any desired degree without any further altering of composition.

3—Such a process as described will permit iron of any carbon and silicon desired to be made by the proper additions of steel and ferrosilicon.

4—Where this duplex process is used, the amount of scrap used in the cupola can be increased and the fuel decreased as it would not be necessary to have the iron as hot as is the practice when poured direct into the molds.

5—The mixtures would have to be kept low in manganese, no high manganese pig or spiegeleisen would be used and it is believed that by using low manganese scrap that the amount of manganese burned out in the cupola would lower this element to the point desired. This will have to be worked out definitely in the future from further experimental data.

6—As to costs, no figures can be given as the process is not believed to be in operation as specifically outlined in this paper. However, the power required ought not be more than 150 to 200 kilowatt hours per ton on molten metal from the cupola and with continuous operation, the labor charges should not be excessive. These costs would be offset by the lower cost of melting stock, reduced amount of coke used in melting and the lower temperature of the annealing ovens for the annealing of such low sulphur iron.

Electric Furnace an Adjunct to Cupola

THE advantages of a duplex process using the electric furnace as an adjunct to the cupola for melting gray iron were outlined by George K. Elliott in a paper presented at the annual convention of the American Foundrymen's association held in Philadelphia, Sept. 29-Oct. 3. The author called attention to the fact that while the cupola is an efficient furnace for melting iron it has certain limitations which prevent it from furnishing an iron which entirely meets the requirements for certain classes of castings. But for the ordinary run of iron castings, comprising possibly 90 per cent of the total output of the country there was said to be no valid economical reason for either displacing or radically modifying the modern cupola.

The author goes on to say that whatever its faults may be, it must be acknowledged that for preheating iron up to the point of melting, and after that performing the fusion itself with a minimum waste of heat, the cupola stands supreme among the established foundry furnaces. Its melting efficiency approximately is 40 per cent although in the hands of the unskilled it may fall as low as 25 per cent, while the adept may drive it along at a rate of as high as 50 per cent efficiency. Although the cupola is practically without rival as a preheater and melter it does not attain the same high rank as a superheater of molten metal. The cupola operator's problem in obtaining superheated iron is largely one of circumventing terrestrial gravitation as it is manifested in the speedy dripping of the molten iron through and away from the hottest zone of the cupola.

In the two-step process that has been described, all responsibility for superheating is taken from the cupola and assigned to the electric furnace, where with the greatest ease it can be superheated to a degree that is not possible in any other kind of furnace. Superheating in the electric furnace enables the foundryman to make castings of low-phosphorus iron which otherwise it would be necessary to make of high-phosphorus iron, because he can safely shift the responsibility for fluidity from the material to the furnace.

Another advantage, and by no means a minor one, is that hot iron tends to increase solidity in castings. By solidity is meant not only closeness of grain but freedom from internal imperfections such as blowholes, shrink-holes, slag inclusions, graphite segregations, and similar defects.

Refining Agents

The process of treating iron in the cupola cannot be extended beyond the point of melting and a certain limited amount of superheating. Any additional operation such as refining, is entirely out of the question and can be performed only in some other kind of furnace. In considering the electric furnace in relation to refining it is preferable to consider separately the acid-lined and the basic-lined furnaces. The acid-lined furnace refines entirely through maintaining a constant reducing atmosphere in contact with the metal. The refining in an acid furnace is one of deoxidation coupled with a freeing of the bath from included gases and slag.

One must turn to the basic-bottom electric furnace to find potentiality in refining at its greatest. Almost any metallurgical reaction may be conducted in it, including oxidation, reduction, dephosphorization, desulphurization, decarburization, carburization, mixing with ferroalloys, superheating, and others. The duplex process for cast iron is chiefly concerned with reduction, desulphurization and mixing.

Standard pig iron containing a maximum of 0.05 per cent, sulphur contains from 0.07 to 0.11 per cent after coming from the cupola, the degree of contamination depending upon the quality of coke, the condition of the cupola and its accessories, and the skill and knowledge of the cupola tender. The same iron from the cupola may subsequently have its sulphur reduced to about one-third or one-fourth by 30 or 40 minutes refining in a basic bottom electric furnace. The average of a great number of *duplexed* heats of gray iron was .088 per cent sulphur in the melt from the cupola, while in the final product from the electric furnace the average was 0.036 per cent. As low as 0.009 per cent sulphur in occasional heats has been produced in gray iron under everyday working conditions.

The electric furnace step of the duplex process is particularly good for mixing. It enables a perfect mixing of the original raw materials, assuring homogeneity in the single heat, and it facilitates the accurate duplication of results, assuring uniformity among several heats. It also simplifies and insures the perfect admixing of alloys such as ferrosilicon and ferromanganese. The electric furnace allows steel scrap to be mixed with the iron and by this means the amount of total carbon in the metal can be controlled, while when steel scrap is mixed with iron in the cupola an indefinite amount of carbon is taken up from the coke.

Educational Value of a Scrap Pile

Defective Castings Are Not Altogether Without Value if They Suggest to the Foundryman's Mind a Method for Prevention of Trouble in the Future—Where Study is Needed

BY HENRY TRAPHAGEN

DEFECTIVE castings—the tenants of the scrap pile—offer to the discerning and ambitious foundryman knowledge that is beyond price. Show the foundry expert the scrap pile, and he will tell you the caliber of the foundry, for evidence of either constructive progress or the senseless repetition of blind ignorance, is indelibly and relentlessly stamped on that tell-tale pile of rusting iron.

It all depends upon whether the defective castings are intelligently examined or are buried away under old barrels, what the real value of the scrap pile will be to the foundry. Intelligently examined and constructively criticized, a defective casting will invariably point out the antidote; but if it is hidden away and treated as an enemy it means that casting after casting will be turned out in the same old way; the customer will be dissatisfied; the foundryman will make no progress; and the establishment itself will finally rest in the financial scrap heap.

The up-to date foundry should have at least one competent, experimental molder, paid by the day, and not hurried; his business would be to investigate the proper method of gating and heading castings as they come into the shop. Every department should be interested, every responsible department head should lend his bit to the fund of general knowledge. The work of the experimental molder should be thoroughly examined, and discussed. If consistent and concentrated effort is made, it will be but a short time before the experimental molder turns out a sound casting.

He May Go to China

When the casting comes right it should be either sketched or photographed with the gates and heads attached, and a permanent record made. If the same job comes back a year or two later it is immaterial whether the experimental molder is in China or the superintendent in parts unknown—that casting can be made again, for the proper method of making it is on record.

It would appear at first sight that experimental molding would be an almost endless task; that the experimental molder would have to start out on an entirely new tack every time a casting came into the shop, and that the number of records necessary would be almost overwhelming, but if foundrymen will carefully investigate this method of experimental work, they will find that after all, the number of real basic defects that are found in castings are comparatively few. They will discover that castings naturally group themselves into a few well defined classes, and that each class is subject to characteristic defects that are easily recognized, and in a short time they will learn to discount possible defects at the start.

Scrap Tells the Tale

THE size and composition of the domestic scrap pile in the foundry yard is a fair indication of the success or failure of the methods in vogue for producing castings. One way to reduce casting losses is to have all new work pass through the hands of a highly competent molder. He should be allowed to experiment until he has arrived at the one best way of making each piece. With a satisfactory method once established, a photographic record should be made showing all the important details. Having this record it would be perfectly immaterial whether the personnel of the foundry changed or not. The records would always be available for whoever needed them.

While it is true that the great majority of castings are lost through some fault in the molding practice, it is equally true that a sufficient number are lost through metallurgical faults to warrant the utmost vigilance on the part of the foundryman, both in buying his iron, and later, in melting it.

Some iron is fundamentally bad and will never produce satisfactory castings. An off heat of pig iron, due to one of a variety of causes which interrupt the even working of a blast furnace, is in this class. So is thin, rusty sheet scrap. Rust is oxide of iron and during the melting process it enters the metal and becomes emulsified. No amount of flux, deoxidizer or cleansing agent will get it out. Suspended oxide is responsible for the rejection of many castings, more especially those which have to undergo pressure tests.

If the foundryman can grasp the broad conception of castings as a whole; if he can master the few fundamental laws of solidifying metal, he will have made no small measure of progress toward the desired end. But unfortunately, it seems to be the common impression that the various branches of iron and steel founding are each peculiar to themselves; for instance, the malleable man imagines that his troubles are quite distinct from those found in the gray iron shop; while the gray iron founder is under the impression that gray iron and semisteel obey laws that were designed especially for them; and it is sometimes amusing to hear the steel man dilate upon the peculiar and mysterious troubles of the steel business

Literature Deficient

Now if the foundryman will only recognize the fact that all these various metals are alloys of carbon and iron; that they all merge into each other without any sharp line of distinction; and furthermore, that they all in general obey the same laws, then, a great light will dawn upon him and he will realize that there are but few real basic troubles in a foundry.

Several fundamental difficulties that are found in foundries have been described in the literature on the subject; but unfortunately these descriptions seem to be lost in a maze of words dealing with the various peculiarities of chemical ingredients, new fangled methods of chemical analysis, long discussions on grain aggregates, and in fact, everything under the sun, except a frank, plain discussion of the foundryman's troubles. It is because of the great difficulties in wading through a mass of literature that the average foundryman has become disgusted with chemists and scientists in general; and judging from the impractical, high-brow contributions that they have given later-day literature, it

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From a paper presented at the twenty-fourth annual convention of the American Foundrymen's association held at Philadelphia. The author, Henry Traphagen, is metallurgist for the Toledo Steel Casting Co., Toledo, O would appear that the foundryman's disgust is well founded.

If the foundryman will carefully study his defective castings the writer believes that he will ultimately agree that all of the defectives can be traced to one of a very few fundamental errors. In general, these fundamental errors may be summed up as follows:

First.—The personal equation, or in other words, the carelessness of the workman.

Second.—Over-production, which puts a premium on careless, sloppy work.

Third.—The attempt to make good material out of junk.

Fourth.—False economy, which results from the use of too little fuel, too much scrap, cheap refractories and too great a reliance in green sand molding practice.

It has been the writer's experience that about 10 per cent of all troubles in the foundry can be traced to the melting department and the other 90 per cent to the molding department.

To produce a good casting from any kind of iron or steel, it is absolutely essential that the metal be hot and fluid. But unfortunately, hot, lively metal is not as common in our foundries as one would be led to expect, and the causes of cold metal may be briefly summarized as follows: The bed in the cupola may be too low. This is a very common error and generally results in cold, sluggish metal. It is a simple matter to determine whether or not the bed is low. Leave the tap hole open, turn on the blast, and note the time that it takes for the first metal to run over the spout. If iron appears in less than 10 minutes, it is almost a certainty that the bed is too low. A low bed means dirty, porous, weak castings, owing to the metal melting directly in front of the tuyere blast and becoming unduly oxidized.

Correct Melting Ratio

Another prolific source of cold metal lies in the attempt to conform to a prearranged melting ratio. In the dictionary of common sense there is no such term as melting ratio. The correct melting ratio is the amount of coke that will give hot, fluid metal; and this amount of coke will vary with the size of the cupola, the amount of scrap used, the kind of coke, the percentage of steel used in the mixtures, and the size and condition of the sprues. It is therefore evident that it is ridiculous for anyone to attempt to lay down a specific melting ratio for cupola practice.

Cold metal in the converter can generally be laid to one or two causes. The metal from the cupola may be cold for one of the reasons just enumerated; the percentage of silicon may be too low for successful blowing, or what is most common, the lining of the converter may be too wet, or there may be a leak in the wind chest or somewhere along the line. It is rarely found that cold metal can be traced to a variation in chemical content, and before the foundryman wastes any time fooling around the laboratory, it is far better for him to examine his cupola practice, his converter linings and his wind apparatus.

Another Cause for Cold Metal

There is another great fundamental cause for cold iron, it is found not only in the cupola, but in the converter, the air furnace, the open-hearth furnace, the crucible furnace and even in the electric furnace.

Reference is made to the effects of oxygen, which causes oxidized metal. There is no disputing the fact that foundries very frequently receive shipments of pig iron that will not produce hot iron, no matter how careful the melting practice may be, and such iron is delivered much more frequently than the average foundryman is aware of. It is useless to check up the analyses of such material, for the blast furnace laboratory report will in nearly every case be correct, and the fact that it is correct furnishes the chief alibi for the furnace.

Pig iron is sold on chemical analysis only, and it is presumed that if the analysis conforms to the customer's requirements the iron must necessarily be satisfactory, but nothing, in my judgment, is further from the truth. The pig iron that generally causes such a long train of disagreeable troubles, such as porous castings, skulled ladles, bunged-up cupolas, etc., is a product of over-production.

If, on breaking a shipment of iron it is found to be consistently unsound and full of gas cavities, reject that iron if it is possible to do so. But if the furnace absolutely refuses to take such iron back, which is too often the case, then the only course left to the foundryman is to hold the shipment in the yard and use it very gradually, say one pig to a charge, until the pile is gone.

The writer has found defective pig iron in practically every kind of a foundry including malleable iron, gray iron and steel plants.

Another source of cold, sluggish iron and steel lies in the use of thin, dirty, rusty scrap. Such material as rusty flashings, turnings, shearings, punchings and other fine voluminous scrap should have no place in the melting furnace, if the melter expects to get sound, healthy metal. Such scrap is being used literally by thousands of tons in our open-hearth furnaces today. It is common in steel foundries, malleable shops and gray iron foundries. But the result is the same, no matter what type of furnace is being used or what kind of product is being manufactured.

Rust is an oxide of iron, and it is finely divided. During the melting process this rust or oxide enters the metal and becomes emulsified. And no amount of fluxes, deoxidizers, or other cleansing agents will get it out. I believe suspended oxides in metal are causing more trouble today in the iron and steel industry than any other one thing. The use of such material is directly at variance with all the sound principles of metallurgy. How long the manufacturers will use this material and how long the consumer will continue to receive such metal is a problem. But the light is breaking and the day of reckoning for the iron and steel manufacturers who attempt to melt up nothing but junk, is close at hand

Cold metal is distinctly a problem for the melting department, but it effects the molding department so strongly that the molder must take it into consideration. It is a well known fact that the moment molten metal strikes the sand a large volume of gas is generated. This gas is formed from the decomposition of binding materials, but most of it comes from the water that is in the sand.

If such gas is not allowed free exit, it is going to be trapped in the metal; the colder the metal is the more quickly it will set, and the more likely it is that the gas will be trapped under a frozen skin.

How many times does a foundry turn out what is apparently a perfect casting only to have it rejected in the machine shop just as soon as the first cut is taken from the cope side. The gas trying to escape has been trapped just below the surface because the metal has set too quickly to allow the gas to get away; this is a very common defect in green-sand molding: hence the necessity when attempting to make green-sand work, of having the metal very hot and fluid and venting not only the cope but the drag, and making sure that the vents in the cores are wide open

The Sins of the Cover Core

An interesting sidelight in connection with this discussion is the question of using oil-sand cover cores. It is a very common occurrence to find a casting made under a thick, hard oil sand cover core, with absolutely no provision for the escape of gas. The foundryman struggles along and probably gets two out of 10 castings whereas if he would merely puncture the cover core with three or four pop heads and let the gas out, the probabilities are that all of the castings would come good.

The question of shrink heads or risers is one that is given too little consideration in the foundry. A head to be of any value, must be large enough in cross section to remain open until the casting has set. It is well to remember that probably not over 30 per cent of the cross section of a head is available for feeding and this statement applies with more than ordinary force to the neck of the feeder; it is folly to make a great big head and then neck it down so narrow that the neck freezes almost instantly, and it is equally futile to expect a head to feed if it is not placed squarely upon the casting. How often does one find a head with a neck say 2½ or 3 inches in diameter about one-fourth of which is attached to the casting and the rest wandering off in space.

The common practice of taking an old splintered block of wood, sticking it to the pattern with a nail, and attempting to make an efficient head is the falsest of false economy. A foundry should have a stock of standard heads carefully made in the pattern shop and fitted with dowel pins so that they can be set squarely upon the pattern with little danger of being misplaced.

Welders Work Overtime

There is a tendency among foundrymen of the present day to skimp on heads. They love to talk about their very low sprue returns but they neglect to state that the welder works overtime every night. Molten metal will shrink as it cools and that shrinkage must be taken up either by overhead feeding or internal chilling, and when a foundryman tries to tell you that his castings are sound without any kind of feeding, that man is trying to change the laws of nature, and personally I cannot see how he expects to get away with it

Another important point is the part that water plays in the foundry. There is probably no other one factor with the possible exception of oxygen, that has so much to do with the success or failure of a foundry. Consider for a moment some of the troubles directly traceable to the old H_2O. In the cupola for instance, we have the well known rubber bottom arising from wet bottom sand; we have cold metal and slow melting from wet coke, wet iron, and moisture-laden air. In the converter we have wild heats, cold metal and cut linings. We find pin holes in the castings due to the metal boiling on the surface of a wet mold; we have entrapped gas and dirt, because too much water in the facing and heap sand has frozen the metal prematurely.

A casting may look sound, but millions of tiny bubbles of exploding steam have made it porous so that it will not stand up under gas or water pressure. All over the country foundries are making hydraulic and ammonia castings by the green-sand method; and they are stoutly claiming the fact that they are getting away with it. Careful investigation, however, will prove that the consumer is kept busy closing up porosities and every so often a truck load of defective castings is brought back to the foundry and is carefully smuggled in the back door, so too many people won't see them. It is possible to make hydraulic castings in green sand molds, but it is not possible to make them day in and day out and be fairly certain that they are all sound. It is almost an impossibility to control the water in the green sand mold; and water suddenly converted into steam has a habit of exploding in the most unforeseen places and in the most peculiar ways. As a general rule, a hydraulic or gas casting should be made in a thoroughly baked mold, and if proper materials are used, and the melting is carefully done and the mold is kept clean, there is no trick in turning out acceptable hydraulic castings.

There is one more item in the molding department that deserves attention and that is the proper method of pouring. The scrap pile receives a great many contributions because of the carelessness or incompetency of the man at the ladle. Every ladle of metal should be held for a minute or two to allow the slag and other impurities to come to the surface. Stopping to allow the metal to clear itself may seem like a waste of time to the modern production hog, but if the gentleman will stand by a ladle and watch the various impurities float up to the surface he will understand why it pays to give the metal time to clear. In the end more good castings will accrue from such practice, and in the final analysis real production will be increased. Metal going into a sand mold should be poured evenly and carefully and under no consideration should hot metal be poured at high pressure directly over a large flat area of sand. Cuts and scabs and snakes are too often the result of fast, furious pouring. It is far better when dealing with a casting having a large flat surface, to cut back-up gates and break the force of the stream of metal rather than resort to a mass of finishing nails, a lot of swabbing and other dodges to prevent the facing from cutting.

Another exceedingly common error is the practice of pouring metal at right angles directly up against a core. If it is possible to allow the metal to slide parallel to the core, there will be far less cutting and much less dirt.

It is obviously impossible for any one man or group of men to enumerate, much less describe, the many apparent defects and troubles that exist in a foundry. If the foundryman will carefully study and examine the defective castings, if he will try to trace out his problems from cause to effect rather than trust to dumb luck, he will find, as stated before, that the real fundamental troubles in the foundry are comparatively few.

The value of a scrap pile lies in the fact that it offers a real course of instruction in foundry practice, and this paper has been written in an attempt to induce the foundryman to commune with his defectives, to study their peculiarities, to grasp the principles of casting in their broadest sense, to realize his responsibility to the community, and finally, it is written with the hope that the foundryman will earnestly strive to manufacture sound castings, rather than alibis and fictitious production sheets.

Show Precipitation Model

A model illustrating the operation of the Cotrell precipitation process for removing flue dust from blast furnace gases was exhibited at the Chemical Exposition in the Coliseum, Chicago, Sept. 22 to 27. This model was made by the General Electric Co., Schenectady, and was shown under personal supervision of Chester T. McLoughlin assisted by Raymond Barclay, both of the General Electric organization.

Training Workers

Training bulletin No. 24, entitled "Industrial Training for Foundry Workers" has been published by the United States department of labor, United States training service, and will be forwarded to any person interested by applying to C. T. Clayton, director, Washington. This report was issued in preliminary form some time ago and published in the July 15 issue of THE FOUNDRY.

The Worthington Pump & Machinery Corp. has taken over the Epping-Carpenter Pump Co., Pittsburgh, the plant of which will be known as the Epping-Carpenter works of the Worthington Pump & Machinery Corp.

Plea for Less Rigid Sulphur Limits

Usual Requirements Regarding Sulphur in Specifications for Cast Steel are Considered too Exacting—Molding, Steelmaking and Annealing Practices are Said to Affect the Casting More Than Somewhat Higher Sulphur Content

BY A. E. WHITE

IT is not the object of this paper to add any new evidence to that which already has been presented. There has been no opportunity, since the writer was requested to prepare a paper on this subject, to make experiments and tests. It is the object of the paper to plead for a thorough survey of the items which affect the quality of steel castings and to judge of their acceptability on the basis of the properties they possess rather than to lay undue emphasis on one or more disputed points.

Considerable has been written concerning the effect of sulphur in steel. Numerous writers have pointed out that sulphur in percentages much above 0.04 or 0.05 gives material showing undesirable qualities. Now and then some one suggests that sulphur in percentages greater than 0.04 or 0.05, possibly as high as twice the values given, in no way affects the quality of the steel. Much that has been written is in the way of exposition and is not supported with evidence. Furthermore, a considerable amount of the evidence submitted is so beclouded by other factors that the data is valueless. Practically all of the literature discussing sulphur deals with its influence in rolled or forged steel and not in cast steel. Between cast steel on the one hand and rolled or forged steel on the other, there is, in the writer's opinion, a vast deal of difference. Therefore the observations on the influence of sulphur in rolled or forged steel, relatively speaking, may have little bearing if applied to cast steel. This, briefly stated, is the status of the question at the present time.

Factors Affecting Quality

Broadly speaking, there are five main factors which affect the quality of steel castings. These are design of castings, composition, molding practice, steelmaking practice and annealing practice.

Included in the molding practice may be listed the kind of mold, whether of green or dry sand; method of venting; weight and location of riser; method of gating; character of cores; length of time mold is kept around metal after pouring, etc.

In the steelmaking practice may be included place of recarbonization, whether in furnace, converter or ladle; size of heat; number of castings to be poured from a given ladle; temperature of pouring, etc.

In the annealing practice may be included the evenness of furnace temperature; the temperature employed; the time consumed in bringing to heat; the time at heat; the time consumed in cooling; the type of castings placed in a given furnace, whether all light, all heavy, or mixed; the type of furnace used, whether a furnace designed for heavy castings employed on light ones or vice versa; character of flame, whether oxidizing, reducing or neutral; etc.

There are times when too little attention is given to the question of design of steel castings. Many designs are made by men who know too little about the characteristics of metal when it is changing from a liquid to a solid. Much improvement in the matter of quality of finished castings could be brought about by closer co-operation between the designer and foundryman, and it is trusted that as time goes on, this suggested closer co-operation will become more and more common.

Purchaser's Inspection

In general, the steelmaking and molding practice is of an acceptable character. In large measure, however, the purchaser is in the hands of the founder since it is not feasible for him to employ as expert a steelmaker or steel founder as the steel-casting operator can afford to do, and only by the employment of an abler steelmaker or founder can he expect to properly pass upon these phases of the process. Even if he can get a man of suitable experience, it is questionable if he should employ him, for by so doing, a status of divided authority in the steel castings plant would develop, and such a condition would be most unsatisfactory and in fact, quite impossible. Also, by chemical, physical and visual tests the purchaser can gather sufficient information regarding the character of the castings to decide whether or not they are acceptable, so that he is not as much at the mercy of the founder as might appear to be the case at first glance.

The writer believes much greater attention should be given to the matter of annealing, in the future, than has been accorded it in the past. As a rule, steel founders have not awakened to the latent possibilities of scientifically controlled annealing. Many furnaces bear indications that the only things thought of in their design are walls, a floor, a roof, and some kind of ports for the admission of heat.

Irregularity in Annealing

There seems to be an utter disregard of such questions as fuel efficiency, through proper combustion and control of heat losses by radiation and by the stack; character of the flame, whether oxidizing, reducing or neutral; scientific temperature control, for in most furnaces there is as much as 200 degrees Fahr. difference in temperature in different portions of the same furnace; accurate temperature measurements, for such furnaces as have pyrometers usually have only one and it is neither frequently calibrated nor does it necessarily record the real conditions in the furnace because of the varying temperature distribution in the same; and care in the selection of only pieces of approximately the same cross section for each furnace per anneal, for there exists a more or less haphazard method of placing castings with different cross sections in the same furnace with the resultant of either overheating the thin ones or failing to remove the dendritic structure in the thick ones.

It was the writer's privilege in the fall of 1916 and the winter of 1916-1917 to visit nearly all of the important steel casting plants in the eastern half of the United States. It was also his privilege to have under his supervision the inspection of all the steel casting plants producing ordnance material for the United States army from January, 1918, until he left the service in March, 1919. As a result of this experience, he has come to feel to a greater and greater extent that the acceptance of steel castings should be placed on a broad basis and that the minute scrutiny of castings for a few hundredths of a

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Paper presented by A. E. White at the Annual convention of the American Foundrymen's association held in Philadelphia, Sept. 29-Oct. 3. The author is a prominent member of the engineering faculty at the University of Michigan, Ann Arbor, Mich., and during the war was an officer in the ordnance department, where he had charge of steel foundry operations.

per cent of sulphur is both irrational and unwise.

To talk about the effect of an increase of 0.01 or 0.02 per cent of sulphur when by improper annealing, improper steelmaking or by improper foundry practice, properties many times worse than those produced by sulphur are acquired by the steel, is, in the writer's judgment, placing undue emphasis on the wrong factor.

Sulphur in steel may increase blow holes—it is granted that this is a disputed point—but assuming that it does, it will not do so to nearly the same extent as an improper temper to the mold; improper venting of the mold or core, especially the core; or an improper pouring temperature. It may increase shrinkage, but it will not do it nearly as much as an improper casting design, an improper pouring temperature, or too rapid a heating or cooling during the annealing. It may decrease the metal's resistance to shock but not to the degree that a poorly designed casting will, or one in which the metal has been overheated, burned or underannealed with the dendritic structure still in evidence.

It was because of the feelings expressed in the preceding paragraph that the writer championed, while connected with the ordnance department, a more liberal specification as applied to sulphur, though accompanied at the same time with such a method of inspection at the casting plant consisting of an examination of test bars, annealing lugs, visual examination, etc., that the real quality of the castings, or as near real as possible might be ascertained

Malleable Foundries Raise Their Standard

THE man who has become accustomed to manufacture a product and have it accepted by his customers without inspection or question does not, as a rule, take kindly to working according to specifications. At first there is usually a little resentment and a feeling that getting defective material by the inspector when possible is all part of the game of business. But after the manufacturer becomes used to working to specifications and begins to understand fully their importance to his own interests as well as those of his customers his entire viewpoint changes and he finds himself constantly striving to improve the quality not only of his own output but that of his competitors' as well.

Specifications requiring physical tests have been applied to rolled and forged steel in different forms for many years and the manufacturers have become accustomed to presenting evidence of quality, either through certificates of test or by having samples of the material tested in the presence of an inspector. But for some reason specifications on castings have seldom been demanded in the past and even now many castings are purchased without the buyer insisting on their meeting definite physical requirements.

Steel castings are purchased on specifications more frequently than others at the present time while gray-iron castings are least often purchased with test requirements. Malleable iron occupies a middle ground. Like all other castings those made of malleable iron are subject to great variation in physical properties if not properly made. In the past this fact has worked against the use of malleable castings in many places for which they are decidedly the most fitted. Some years ago, of all the foundries producing malleable castings, none was making iron having as good physical properties as it is practicable to attain, and frequently the castings had a tensile strength of less than 40,000 pounds per square inch.

Under these conditions many consumers, especially among the railroads, were loath to call for malleable where steel castings could be used. Some of the most progressive of the malleable iron foundrymen who were making a good grade of iron realized that something should be done to improve the quality of their own metal as well as that coming from foundries whose standards were low.

This question was brought before the American Malleable Castings association which decided to take steps to improve the general quality of the iron made by all its members and to assist those foundries among its membership which were making castings with physical properties below the average. In order to accomplish these ends arrangements were made, several years ago, with Prof. Enrique Touceda, Albany, N. Y., to carry on research work, test samples from member foundries, and to visit those foundries needing metallurgical advice.

Soon after the inauguration of this work the quality of the output began to improve in all of the foundries affected and those which were turning out the lower strength iron were helped to bring their metal more near the average of the other foundries. When these results were accomplished, the association began to urge higher requirements in specifications for malleable castings in order to inspire greater confidence among the users of this material

The members of the association are privileged to send daily samples to the laboratory of Enrique Touceda for test, and if the physical properties of the test pieces do not come up to the standard set by the association, the foundry making the particular iron is assisted to improve the quality of its metal. This system having proved successful, the association has recently taken another step to improve the quality of the malleable castings output of the country.

The new plan is to issue a certificate to each foundry which for three months has sent daily samples for test, in cases where every one of these samples has met the requirements of the association as to physical qualities. At present a minimum of 45,000 pounds per square inch tensile strength and 7.5 per cent elongation in 2 inches is demanded of foundries making railroad, motor vehicle, agricultural implement and general machinery castings.

For the quarter ended June 30, 1919, 32 members of the American Malleable Castings association out of a total of 62 have a continuous record for three months of meeting the requirements laid down. These requirements are the same as those given in the standard specifications for malleable castings of the American Society for Testing Materials.

Welding Gray Iron

By H. E. Diller

Question—We have difficulty in obtaining a soft, machinable weld on small gray-iron castings. Please inform us how to make a weld which will be soft and easily machined.

Answer—In welding small gray-iron castings care should be taken to have the entire casting heated to at least 200 degrees Cent. before starting to weld. Iron having 2.75 to 3 per cent silicon should be used for the welding rods. The casting should be cooled slowly after welding.

If you follow these instructions you should have no trouble but if you do experience any difficulty, heat the castings a little higher before welding and anneal them at 500 degrees Cent. after the welding is finished. The castings should be cooled slowly as indicated.

Making Steel in the Iron Foundry

A Side Blow Converter Installed in a Gray-Iron Foundry Could Take Care of Miscellaneous Cast Steel Requirements—Low First Cost of Converter an Advantage

BY GEORGE P. FISHER

STATISTICAL reports of the American Iron and Steel institute, classifying the steel castings produced in the United States according to the process used for melting and refining, contain the following production figures in gross tons for 1916 and 1917:

	1916		1917	
	Gross Tons	Per Cent	Gross Tons	Per Cent
Open-hearth ...	1,176,449	85.76	1,213,156	84.16
Converter	142,791	10.41	159,272	11.05
Crucible	9,351	0.68	3,834	0.26
Electric furnace..	42,870	3.12	64,911	4.50
Miscellaneous ...	302	0.03	231	0.02
Total	1,371,763		1,441,407	

At the date of this paper the figures for 1918 have not been published.

Each of the three principal processes for the manufacture of steel castings has advantages and disadvantages as compared with its rivals, and each has its own separate and distinct field of operation. As shown by the above figures about 84 per cent of the tonnage of steel castings is credited to the open-hearth furnace, 11 per cent to the converter, 4.5 per cent to the electric furnace and 0.5 per cent to the crucible and miscellaneous.

Any foundry proposing to manufacture steel castings must consider which process will prove most economical and satisfactory for its particular class of work. With a proper selection of raw materials and the requisite amount of care and skill, good castings can be produced by all three processes, and it is equally true that without proper care and skill very poor castings can be produced by any of the processes mentioned.

Practically all heavy castings, by which we mean those weighing from 500 pounds up, and having sections of ½ inch or more, are cast from open-hearth metal. Where large tonnages are desired and where the sections of metal permit the use of relatively cold steel, without excessive loss due to misrun castings, this process is usually the first choice. It is considered essential for economical operation that the furnace be operated continuously for 24 hours per day and when conditions permit this, open-hearth steel can be made at a lower cost than steel by any other process. An open-hearth shop requires relatively more floor space per ton of castings produced because the heats are larger and are tapped at less frequent intervals.

Steel foundries are classified roughly as those specializing on heavy work and those specializing on small light work. In the latter class we invariably find the electric furnace or the side-blow converter. These two processes practically monopolize this field because of the extremely high temperature attainable in the melted metal by either of them. With either the electric furnace or the converter no difficulty is encountered in tapping steel at from 3000 to 3200 degrees Fahr., which permits the manufacture of castings weighing as little as 2 to 3 ounces each, and having sections as light as ⅛-inch. The modern steel foundry specializing on light work accepts orders for castings which used to be considered too small and intricate for any but malleable foundries.

Electric Furnace

The arc-type electric furnace has become an important factor in the steel casting industry since 1915, during which year 23,064 gross tons of steel castings were made in electric furnaces. Furnaces of this type are able to produce metal of sufficiently high temperature to cast the lightest and most intricate castings, and can be operated with either basic or acid linings. Because of their neutral non-oxidizing atmosphere they can use very light scrap or even steel turnings. A few electric furnaces are known to be charging 100 per cent scrap and borings, and all of them are using a very high percentage of old metal, probably 85 per cent or more.

A very high degree of metallurgical skill is necessary for the successful operation of an electric furnace, and for economical results the furnace should make steel continuously for 24 hours per day. Only by continuous operation can reasonable power costs be maintained, and the cost of power is one of the most serious considerations in producing electric steel. Even when it can be obtained at as low a cost as one cent per kilowatt-hour, the power cost per ton of metal melted, with good practice, is in the neighborhood of $6.50 to $7.50. With poor practice the costs are very much higher. Electric furnace manufacturers publish figures showing that electric furnace metal can be produced at a cost about on a par with open-hearth steel and about one cent per pound lower than converter steel. These figures no doubt hold good under conditions of continuous furnace operation and cheap power rates, but not under ordinary conditions.

The side-blow converter is in operation in about 100 steel foundries in the United States. It has been used for the manufacture of small steel castings for nearly 20 years and the production of castings has increased from 14,000 tons in 1903 to 159,000 tons in 1917. Only the electric furnace can compete with the converter in producing temperatures which permit the casting of very light sections and small intricate shapes. The great advantage of the converter over all other processes lie in its great flexibility, ease of operation and small initial investment. It can be placed in operation on an hour's notice and can produce 20 heats per day or only two or three at practically the same cost per heat. Heats are blown in from 12 to 15 minutes each. When not in operation it requires no attention and the only costs against an idle converter are depreciation and interest on investment, both of which are negligible. The heats are small and produced at short intervals, permitting floor space to be used over several times during the day.

The usual charge in converter practice consists of 40 to 50 per cent of pig iron and 60 to 50 per cent of scrap. The author has seen a converter operated successfully on 100 per cent of steel scrap by adding ferrosilicon to bring the silicon content to the required figure. Because the converter must be operated with an acid lining, it is necessary to purchase raw material having a low phosphorus and sulphur content.

Many plants operating an iron foundry have a demand for steel

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Paper presented by George P. Fisher at the annual convention of the American Foundrymen's association held in Philadelphia, Sept. 29-Oct. 3

castings. Where this demand is intermittent and not for a large tonnage, the side-blow converter is an ideal installation. The melting equipment for the gray iron foundry and for the converter steel foundry is the cupola, which is already installed. When steel is required the metal can be melted in the same cupola ahead of the gray iron mixture. The converter occupies very little floor space and requires no attention when idle.

In the case under discussion we are assuming a demand for a small tonnage and in this case initial investment is worthy of serious consideration. The converter can be installed and put in operation for approximately one-sixth of the cost of an electric furnace and one-half to one-third the cost for an open-hearth furnace.

Perhaps the most important factor is the ease with which a converter can be operated. It is unnecessary to employ a high-priced furnace operator who is of little or no use when there is no demand for steel. The foundry foreman or any intelligent employe can be trained in a very few weeks to operate a converter and produce good steel. If only two or three tons of castings are required per day the time necessary to blow the steel takes perhaps an hour per day of the foreman's time, which interferes with his regular duties only to a very small extent.

Because of the speed with which steel can be produced and the high temperature of the metal it is possible to accumulate two or three blows from one converter in the same ladle to pour an occasional large casting. This is impossible by any other process for making steel and is a great advantage in a shop where it is impossible to predict what size of casting will be demanded. While large castings weighing several tons each can be made as just described from a 2-ton or even a 1-ton vessel, the converter finds its greatest application in the manufacture of small and very light-sectioned castings.

Threaten Increased Duty on Graphite

RECENTLY two bills were introduced in the house of representatives, which provide an increased duty on imported graphite and fire clay suitable for use in the manufacture of crucibles and other foundry supplies. The tariff proposed would be from one cent per pound up to six cents per pound according to the grade of the material. The apparent object of these bills is to protect the miners of domestic graphite but this legislation if passed would tend to work a serious hardship on the foundry business as well as on other industries using graphite. The Foundry Supply Manufacturers association has taken up the question in order to show what effect the passage of the bills would have upon the foundry business and indirectly upon the cost of manufacture in all lines using foundry products.

The bills as introduced read as follows:

"H. R. 5941.—A bill to provide for the national security and defense by encouraging the production and refinning of graphite (plumbago, silver lead) ores in the United States and in its possessions, and to provide revenue for the government of the United States.

"Be it enacted by the senate and house of representatives of the United States of America in congress assembled, that on and after the day following the passage of this act there shall be levied, collected, and paid upon the articles named herein, when imported from any foreign country into the United States or into any of its possessions, the rates of duties which are herein prescribed, namely:

"First.—Crude graphite ores, crystalline or amorphous, 1 cent per pound of ore for ores containing 50 per centum or under of graphite carbon, 2 cents per pound of ore for ores containing over 50 per centum of graphitic carbon, the term crude graphite ores being defined for the purposes of this act as ore which has not been subjected to any process of refining or concentration which changes the graphite content of the ore as mined.

"Second.—Lump and chip crystalline graphite (plumbago, silver lead), 3 cents per pound of graphite, the term lump and chip being defined for the purposes of this act, as larger crystals of graphite more or less broken up in mining and treatment, of a size which will not pass through a screen with openings one-quarter of an inch square.

"Third.—Flake crystalline graphite (plumbago, silver lead), crude concentrates and refined flake, 6 cents per pound of graphite, the term flake being defined for the purposes of this act as smaller crystals of graphite more or less broken up in mining and treatment, of a size which will pass through a screen with openings one-quarter of an inch square.

"Fourth.—All other products, manufactured materials, and compounds containing graphite, crystalline, or amorphous, not specifically provided for in this act, 5 cents per pound for the graphite contained therein."

"H. R. 5547. A bill to repeal paragraph 450 of an act entitled 'An act to reduce tariff duties and to provide revenue for the government, and for other purposes,' approved Oct. 3, 1913.

"Be it enacted by the senate and house of representatives of the United States of America in congress assembled, that paragraph 450 of an act entitled 'an act to reduce tariff duties and to provide revenue for the government, and for other purposes,' approved Oct. 3, 1913, be, and the same is hereby, repealed.

"Sec. 2.—That on and after the day following the passage of this act there shall be levied, collected, and paid upon all clay suitable for or used in the manufacture of graphite or other crucibles, or used in the manufacture of glass melting pots or tank blocks, when imported from any foreign country into the United States, or into any of its possessions except the Philippine islands and the islands of Guam and Tutuila, a duty of 10 dollars per ton."

As will be seen from a study of these bills the price of imported graphite and of clays for crucibles would be materially increased. Graphite, silver lead or plumbago, as it is called in the foundry industry, is used in foundry facings and for finishing molds and the imported varieties would be increased 50 per cent in cost. Graphite also enters into the manufacture of crucibles used in brass and other nonferrous metal casting shops and in the manufacture of crucible steel. The cost of such crucibles would not only tend to be increased by the cost of graphite but also by the extra cost of clays as provided by one of the proposed laws.

It is estimated that fully 80 per cent of the graphite used for foundry facings is imported. So far no graphite has been found in this country of a quality which will fully replace the foreign graphite obtained from Ceylon, Canada and Mexico, either for foundry facings or for crucibles. This was made apparent in regard to crucibles during the war when it was next to impossible to obtain crucibles which would have more than half the length of life of the crucibles made previous to the war from foreign graphite and clays. The necessity for having the proper grade of graphite for facing molds is seen when a rough, scabby casting results from the use of an inferior grade of facing.

Unfortunately graphite cannot be worked over to secure the grade desired as is the case with many grades of ore which can be made into any kind of steel according to the process used; but little can be accomplished in the way of securing a high-grade graphite from one which is inferior as it comes from the ground. This leaves little alternative but to use an inferior grade of domestic graphite or to import material of the quality desired and pay the increased price.

How and Why in Brass Founding

By Charles Vickers

Alloying Lead With Zinc

We have a large quantity of white-metal scale weights to make weighing ½, 1 and 1½ pounds each. The specifications demand an alloy of 90 per cent zinc, and 10 per cent lead. We have not been able to get the lead to mix with the zinc, although we have tried various ways. The lead always goes to the bottom of the pot. We would like, therefore, to know if this mixture can be made, and if so, how. We presume these weights are specified in zinc to have a cheap, hard metal, and the lead is specified to add weight and take up some of the shrinkage. If this mixture cannot be made we would like to have you suggest a cheap, hard mixture that could be used in its place.

Lead and zinc only alloy in limited proportions, much less than 10 per cent lead to 90 per cent zinc, therefore, while it may not be impossible to get these metals to remain together in the percentages named, it will never be done by simple melting and stirring the two metals. The two metals have no affinity for each other and the result is that the lead settles to the bottom when the molten, mixed metals are allowed to stand. We, however, would not like to go on record with the statement that these metals cannot be held together in any proportion, because the case is very similar to that of copper-lead alloys, and aluminum-lead alloys, the lead will separate from all of these metals, but in practice alloys of copper and lead are being made containing all proportions of lead. Some of these alloys resemble babbitt, but have a high melting point because high in copper. In the case of aluminum-lead, alloys of these two metals are being made containing up to 10 per cent lead. To make these mixtures is a trick in alloying, known to those who have studied the matter and have done the necessary research work. Naturally, information on the subject is difficult to get, as the secret is guarded by those who possess it. Alloys of lead and zinc possess no commercial importance, therefore, few have done any experimental work to learn how to hold the metals together when solid. It could no doubt be done by the addition of some third metal that had affinity enough for both lead and zinc to hold them together. In this connection, possibly magnesium would be worth a trial. We believe that as a very cheap alloy is demanded the addition of a third metal would make the alloy too costly, and that the better way would be to make an alloy of zinc 98.50 per cent, lead 1.50 per cent, and to enlarge the patterns to compensate for the lower specific gravity of this alloy, as compared with the alloy specified.

The weights could also be cast in the ordinary leaded zinc used for making common brass, and brought up to weight by pouring lead into cavities made for the purpose.

Formulas for Muntz Metal

Can you advise us regarding the composition of Muntz metal, or where same can be purchased?

Muntz metal is a yellow brass first used extensively as a sheet metal for sheathing ships. It was patented in England in 1832 and was named after the inventor. The first specifications were copper 60 per cent; zinc 40 per cent. A third patent in 1846 specified, copper 56 per cent; zinc 40.75 per cent, and lead, 3.75 per cent.

At the present some makers claim the zinc should not be higher than 38 per cent. The following are analyses of two alloys:

	Per cent	Per cent
Copper	60.52	59.52
Zinc	38.80	39.43
Lead	0.40	0.74
Nickel	none	0.39

For casting purposes use copper, 58.50 per cent; zinc, 40.00 per cent; tin, 0.50 per cent, and 10 per cent aluminum bronze, 1 per cent.

Muntz metal can be purchased from any concern specializing in ingot metals.

Bronze Propeller Mixture

We would like to have a good mixture for a bronze propeller.

The mixture will vary depending on the diameter of the propeller desired.

The best alloy to use for propellers is manganese bronze, but it must be of the highest grade and not simply a yellow brass with a little aluminum added. For a small propeller a good grade of red brass can be used, and suitable alloy is the following: Copper, 88.50 per cent; tin, 6.50 per cent; zinc, 3.50 per cent, and lead, 1.50 per cent.

Alloy for Match Plates

Can you advise as to a satisfactory material for making patterns for match plates?

For making patterns for match plates, a white metal is very satisfactory. Such an alloy can be made of zinc, 50 per cent and tin, 50 per cent. Melt the zinc first, then add the tin gradually. Before adding the tin however it is advisable to add a piece of sheet aluminum 2 inches long and 1 inch wide, the thickness of ordinary cardboard. This alloy is suitable as it possesses so little shrinkage that rapping of the master patterns before drawing them out of the sand usually makes up for the shrinkage.

For the pattern plates themselves, use aluminum alloy of the composition, aluminum, 92 per cent; copper, 8 per cent.

Sometimes the match and patterns are cast solid of plaster of paris, in which case a drag is rammed up and the joint finished carefully, then an interchangeable cope is placed over the drag, and is filled with plaster. When set the patterns are trimmed and shellacked. Two blocks are required, one for the cope and another for the drag.

Formula for Roll-Neck Bearings

We would like to obtain the formula for a bronze for roll-neck bearings, to be cast in iron molds. These bearings are not for heavy duty rolling. The largest rolls are approximately 12 x 36 inches.

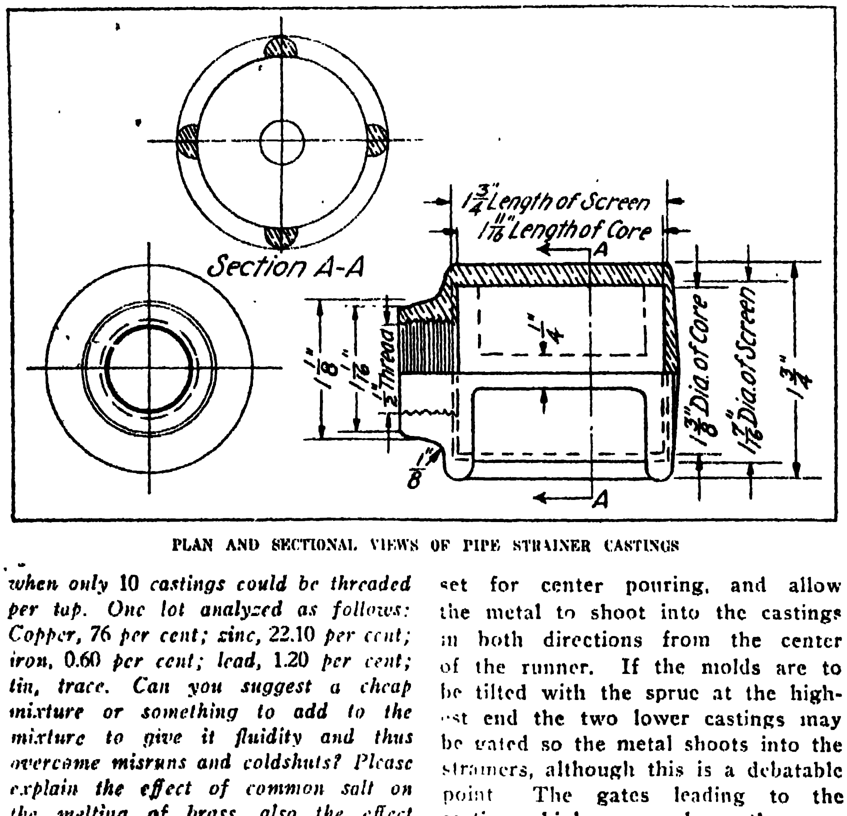
The following formula will give a bronze that will be suitable for the purpose outlined: Copper, 86.50 per cent; tin, 8 per cent; lead, 5 per cent, and phosphor copper, 0.5 per cent. The phosphor copper should contain 15 per cent of phosphorus. If the alloy fails to run as well as desired, the phosphorus can be increased, deducting the increase of phosphor copper from the copper content of the alloy.

Prepare the chills by warming them and then painting with a mixture of lard oil and plumbago, thin enough to flow from the brush. Apply a layer of French chalk over the oil and plumbago with a smooth camel-hair brush. Have a heavy riser in a dry sand head.

Casting Defects Remedied by Changing Gate

We have experienced considerable difficulty in getting good castings for the pipe strainers shown in the illustration. The castings consist of a brass cage with solid bottom and a circular, threaded top, and the sides of the cage are formed of brass screen held in place by the ribs on the casting which join its bottom and top. The screen is cast in place being wrapped around the core, which shapes the inside of the cage. The difficulty consists of cold shuts and misruns. The percentage of loss is high.

We use scrap yellow brass with possibly some valves thrown in, which is melted in an oil-fired furnace. We add several ounces of aluminum to aid in running the metal but there is no phosphorus present. The machining qualities have been good until recently when only 10 castings could be threaded per tap. One lot analyzed as follows: Copper, 76 per cent; zinc, 22.10 per cent; iron, 0.60 per cent; lead, 1.20 per cent; tin, trace. Can you suggest a cheap mixture or something to add to the mixture to give it fluidity and thus overcome misruns and coldshuts? Please explain the effect of common salt on the melting of brass, also the effect and the advantage of using boron, and what effect lead has on the machining quality of brass in different percentages Does a brass with as high a lead content as 20 or 30 per cent resist machining by becoming gummy?



Section A-A
$1\frac{3}{4}$" Length of Screen
$1\frac{11}{16}$" Length of Core
A
A
$1\frac{1}{8}$"
$1\frac{1}{16}$"
$\frac{1}{2}$" Thread
$\frac{1}{4}$"
$\frac{1}{8}$"
$1\frac{3}{8}$" Dia. of Core
$1\frac{7}{16}$" Dia. of Screen
$1\frac{3}{4}$"

PLAN AND SECTIONAL VIEWS OF PIPE STRAINER CASTINGS

It is assumed these strainers are cast horizontally with the parting line of the mold passing through the centers of two opposite ribs, which leaves one rib at the highest point of the cope. If the strainers are made this way the rib at the highest point will be the one to misrun most often. If the castings are placed lengthwise of the flask and the mold is tilted, a gate at one end and entering the side of the casting will run them. But if the gate is cut so as to form an acute angle with the runner so the metal can shoot into the strainer, the castings at the top of the mold which are nearest to the sprues, will be misrun in the majority of cases. This is due to the fact that the metal does not fill the strainer when it shoots in but passes on down the runner and leaves a little metal in the upper strainer molds, which of course immediately sets. If the gates are so adjusted on the plates it would be better to pour the molds on the level with the sprue at one end. In pouring the molds on the level it is better to locate the sprue in the center of the mold, provided the branch gates to the castings are set for center pouring, and allow the metal to shoot into the castings in both directions from the center of the runner. If the molds are to be tilted with the sprue at the highest end the two lower castings may be gated so the metal shoots into the strainers, although this is a debatable point The gates leading to the castings higher up along the runner must be so cut that the metal will shoot past them and strike the bottom of the runner first, then as it floods back it will fill all the upper strainers uniformly and there will be few coldshuts. It is difficult to decide without a test just what is the best way to run these castings; whether on the level or on an incline. but if they are poured on the level we believe it would be the best to center gate them; that is pour from the center of the mold. In the latter case, it would be well to increase the height of the pouring head if possible to do so without adding to the molding costs. If this is not possible the metal will have to be poured rather hot and poured very decisively.

We would also suggest a trial of the following alloy for these castings: copper, 56.50 per cent; zinc, 40 per cent; lead, 3 per cent; aluminum, 0.50 per cent. If the alloy does not cut with sufficient ease, the lead can be increased to 5 per cent at the expense of the copper. Then if the metal appears too brittle the zinc should be lowered a little. Also before weighing the flasks, take a gate cutter and cut a channel in the sand of the cope over each row of castings. This lets the gas off and greatly aids in running the castings. The reason the alloy the analysis of which is given, is difficult to machine is due to the iron content. The high percentage of iron is obtained from the scrap. This is one great objection to the use of scrap for such castings. for by increasing machining costs a mixture using scrap often makes the castings more costly than if they had been made entirely of new metal.

Salt protects brass when melted with it because the salt volatilizes and fills the crucible and a part of the furnace with fumes. These fumes are so persistent that once salt is added in quantity it can be detected for several melts, even if no more is added.

Boron has no effect on brass because like carbon it is insoluble in copper and its alloys. Its salts such as borax and boric acid makes good fluxes as they dissolve oxides, but should not be used in quantity as then they would carry away copper. Metals that absorb and retain carbon, absorb and retain boron, thus aluminum and iron take up boron, and so does nickel, but if boron aluminum that is brittle with boron is added to copper the boron is lost by being thrown out and oxidized immediately and absolutely no effect is obtained by adding the boron. The effect is exactly the same as when cast iron and copper are melted together; the two will not mix because the iron has a greater affinity for its carbon than it has for copper but if aluminum is added the copper and the iron unite and the carbon held by the iron is released and bobs to the surface of the melt as a flocculent dross. The aluminum acts as a cement because it combines eagerly with both copper and iron. The effect of lead is to improve the machining qualities of brass in all proportions. Alloys containing as much as 66 per cent of lead are white in color and machine perfectly.

Getting Ready for Huge Production

Details of Plant Built Expressly to Handle a Large Tonnage of Motor Castings Expeditiously — Forced and Induced Draft Used in Drying the Cores — Castings Poured Continuously

BY PAT DWYER

If Pere Marquette, the black-robed Jesuit, could have looked into the future while engaged in that perilous search for the sources of the Mississippi, he would have felt both gratified and disappointed. His explorations in the country now called Michigan were carried on under the impetus of the society's motto, "for the greater glory of God," and his own patriotic desire to acquire new territory and thus add to the power and prestige of France. He would have been gratified to know that the land which he claimed in the name of his Louis XIV was destined to become great, rich and prosperous from the exploitation of her apparently inexhaustible lumber and mineral resources, but he would have felt disappointed because she was destined to pass so soon and forever from under the aegis of the Fleur-de-lis.

The immense forests, which forced Marquette to do all his traveling by birch-bark canoe, laid the foundation in the lower peninsula for the growth of Detroit, Saginaw and Bay City. Millions of feet of white pine floated down the rivers and were squared into lumber.

The picturesque rivermen, with their little cocked hats, peavies and spiked shoes are becoming a thing of the past and the lumber industry although still important, is no longer in the limelight. The manufacture of motors and motor-cars is now the premier industry of Michigan. Immense plants have been erected in various parts of the state for this purpose and in spite of their tremendous output they cannot keep pace with the demand. Large foundries are operated in connection with nearly all of these plants.

One of the finest and most modern of these foundries has been built recently in Saginaw, Mich, at a cost of $3,000,000, for the Saginaw Product's Co., a subsidiary of the General Motor's Corp. This foundry was designed by Frank D. Chase, Inc., industrial engineers, Chicago, and built under their supervision. The property assigned for foundry development is served by several spurs from the Pere Marquette railroad and covers 65 acres. The present plant covers approximately one-third of this area and it is the intention of the company eventually to erect two other similar units, thus utilizing the entire property. The first unit now completed, is expected to furnish employment for 900 men who will turn out 200 tons of cleaned castings daily. Many of the appliances and special features about the plant were installed at the suggestion of J. J. Wilson, general foundry superintendent for the General Motor's Corp., who drew on his unusually wide experience in the production of automobile castings.

The group of buildings comprising the first unit consists of a foundry building, 165 x 450 feet; a cupola room, 40 x 163 feet; a coreroom, 101 x 390 feet; a cleaning room, 110 feet 6 inches by 281 feet 9 inches; a 2-story pattern building, 158 feet 10 inches by 100 feet; and a washroom, dining room and office building, 201 feet 6 inches by 80 feet 3 inches. The powerhouse is situated 100 feet west of the cleaning room. One of its outstanding features is a radial brick stack 225 feet high by 9 feet in diameter at the top. This building takes the shape of an L, 86 feet 6 inches by 93 feet 9 inches.

The walls of the buildings are of brick and steel construction while the roofs are built of gypsum tile. This material is a non-conductor and prevents condensation. An A-frame on the roofs of the coreroom and cleaning room and a modified Pond truss on the foundry building, together with an almost con-

FIG. 1—ELECTRIC MONORAIL HOIST FOR HANDLING THE IRON

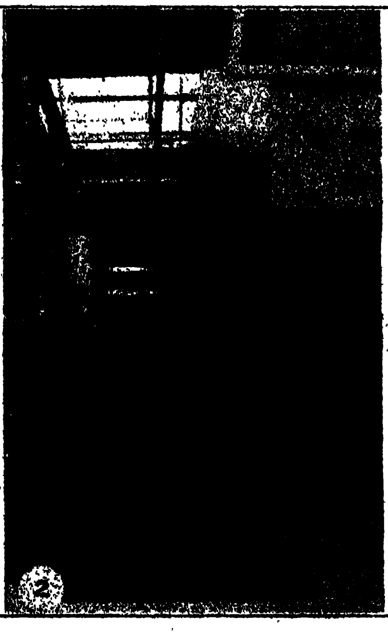


FIG. 2—CORE-SAND HOPPERS AND CONVEYORS FOR THE MIXING MACHINES.

FIG. 3—ONE OF THE BLOWERS AND SYSTEM OF PIPING FOR SUPPLYING THE SHOP WITH HOT AIR

tinuous sash in the walls insures ample light on the floors. In addition, the buildings are all painted a light yellow on the inside which renders the lighting conditions ideal. The sash in both walls and roof are movable and are operated electrically. This simplifies the ventilation problem to a considerable extent.

A group of three 600-horsepower Edgemoor boilers supplies steam for heating the buildings and also for operating three direct steam-driven Ingersoll-Rand air compressors, two being 1500 and one 1200 cubic feet capacity. Coal is used for fuel. It is taken from the cars and passed through a crusher, after which it is lifted into a hopper by a bucket conveyor. From the hopper it is fed to the boiler-room by gravity through a chute.

Electric power, which is purchased from outside interests, is supplied at 2200 volts, 3-phase, 60 cycles. The connected load totals 1400 horsepower, the lighting load being 150 kilowatts. Three transformers step down the voltage to 440 volts for the power load while a smaller set handles the lighting load. By means of a motor-generator set, direct current is supplied for operating the cranes. The generator sets, which are duplicated to cope with emergencies, are housed in a room in the northeast corner of the foundry building.

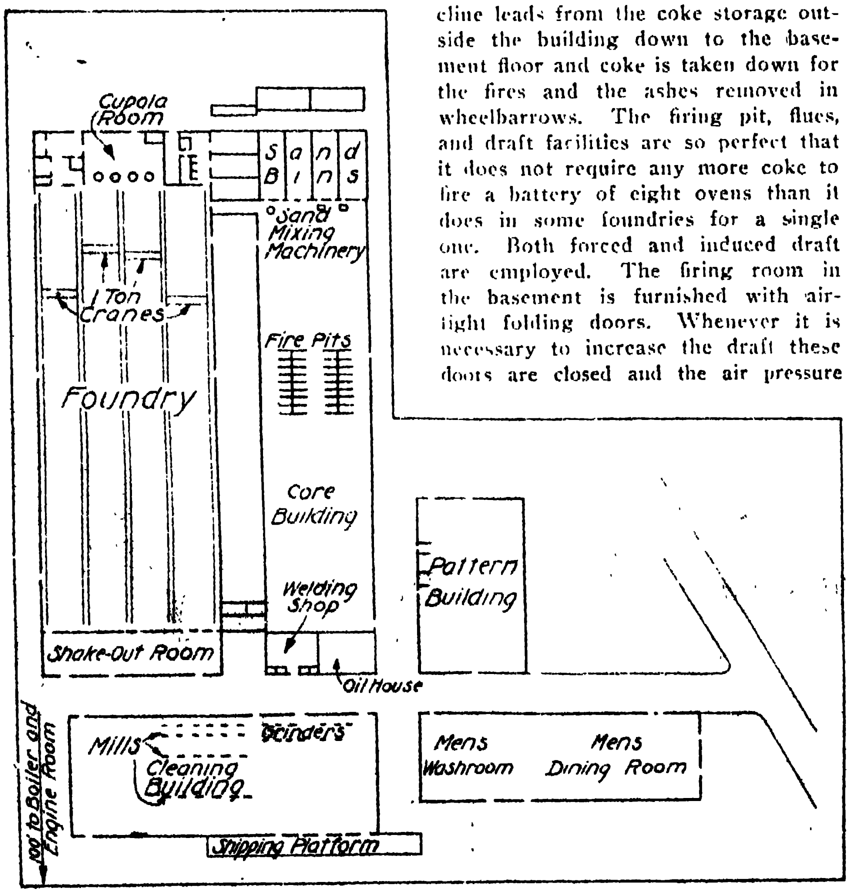


FIG. 4—FLOOR PLAN CENTRAL FOUNDRY, SAGINAW PRODUCTS CO.

Since cores enter so largely into the production of automobile castings it is only natural that the coreroom of this plant should occupy nearly as much space as the foundry. It is the same length as the foundry and only 53 feet less in width. The 32 core ovens were built by Holcroft & Co., Detroit. They are arranged back to back with eight in a row making two batteries of 16 each. Each oven is 12 by 6 feet 6 inches by 7 feet. A continuous flue runs under each row of eight ovens, terminating in an individual stack. There are two openings in the floor of each oven connected with the flue. They are provided with dampers controlled by chains which hang down outside the door. Two outlets are provided in the side walls for the gas and steam, one opening near the top and the other below the floor level. These openings are provided with slides operated from the outside. With these dampers it is possible to control the temperature in the oven quite closely. A pyrometer is attached to each oven in order to keep a record of the heat fluctuations.

The fire boxes for the ovens are in the basement. A long concrete incline leads from the coke storage outside the building down to the basement floor and coke is taken down for the fires and the ashes removed in wheelbarrows. The firing pit, flues, and draft facilities are so perfect that it does not require any more coke to fire a battery of eight ovens than it does in some foundries for a single one. Both forced and induced draft are employed. The firing room in the basement is furnished with air-tight folding doors. Whenever it is necessary to increase the draft these doors are closed and the air pressure raised by a fan, on the same principle as that in use in the fireroom of a battleship.

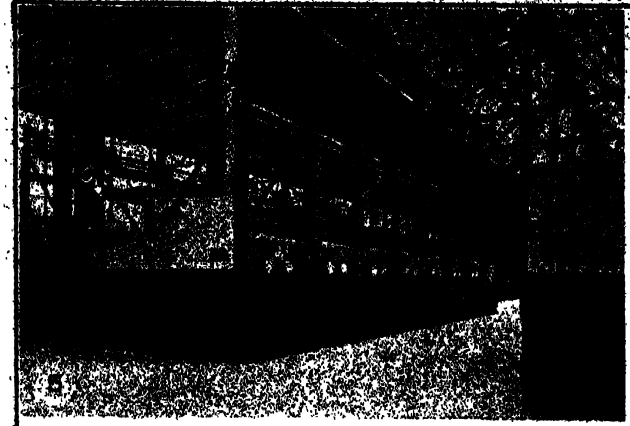
The stack for each battery of ovens is situated at the opposite end from the fire box. They are clearly shown in Fig. 5. This illustration also shows a fan driven by a 15-horsepower motor, connected to both stacks and used to furnish the induced draft necessary. The cores are loaded on racks and taken in and out of the ovens on electrically operated trucks.

The ovens are situated midway from both ends of the building. Their general appearance and relative size in comparison to size of the building are shown in Fig. 8. Provision has been made for doubling the number of ovens if necessary. The basement extends under the space required for additional batteries, a temporary brick wall shutting off the space used at present in order to render it air tight when the forced draft is in use.

Among the many kinks to be found around this plant may be mentioned the cams shown on the posts beside the oven doors. When these cams are thrown up the door has plenty of latitude in the guides and will not jam when being pulled up or down; when the handles of the cams are pulled down they force the door tightly against the guides thus preventing any of the heat from escaping.

Core-oil is stored in a large tank below the ground level, immediately outside the south wall of the coreroom and in line with the core ovens.

The core sand is stored in four concrete bins each 25 x 63 feet having a total capacity of 8000 tons. They are roofed over and the sand transferred to them from the railroad cars by means of grab buckets having a capacity of 1¼ cubic yards each. Each pair of bins is served by a 5-ton Pawling & Harnischfeger crane. Adjacent to the bins and opening into the coreroom are three double hoppers, that is each hopper has a dividing wall in the center. These hoppers, which are loaded from the sand bins on the outside by the cranes, discharge on the inside of the building into a battery of mixing machines. Front and side views of the hoppers and machines are shown in Figs. 2 and 7. There are two revolving screens and mixers built by the Standard Sand & Machine Co., Cleveland, and one No. 2 Simpson pan mixer built by the National Engineering Co., Chicago. The Standard machines are equipped with worm conveyors and bucket elevators for lifting the sand from hoppers in the floor to the screens. Each mixing



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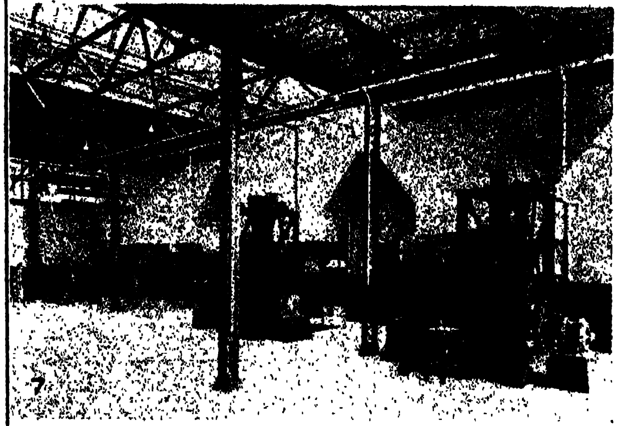

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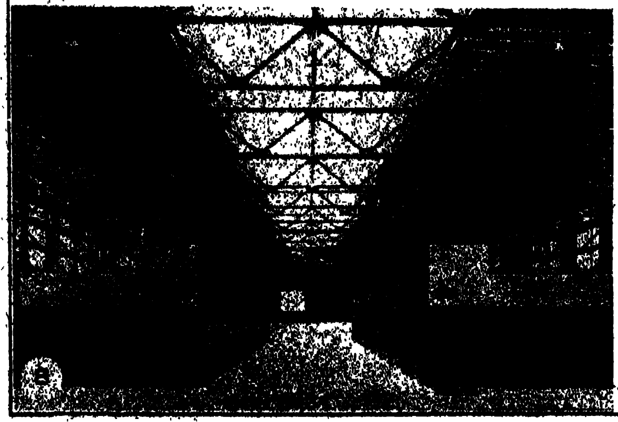

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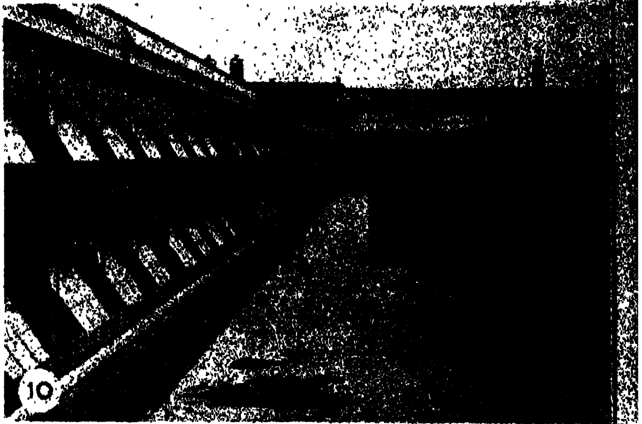

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FIG. 5—ONE OF THE BATTERIES OF CORE OVENS, SHOWING THE UPPER FLUES, THE STACKS AND THE FAN FOR SUPPLYING INDUCED DRAFT FIG. 6—FIRING ROOM FOR OVENS. FIG. 7—CORE SAND HOPPERS AND MIXING MACHINERY FIG. 8—TWO BATTERIES OF OVENS ARE PROVIDED FIG. 9—CORE SAND BINS AND HOPPERS FIG. 10—COURT BETWEEN COREROOM AND FOUNDRY FIG. 11—FOUNDRY INTERIOR LOOKING TOWARD THE CUPOLAS FIG. 12—FACING SAND MIXERS

unit is driven by an individual motor.

The coreroom and foundry buildings, which are parallel, are separated by a court, as shown in Fig. 10. This court is 40 x 360 feet and is paved with concrete. It facilitates the lighting of the two buildings which face each other. The two buildings are connected at both ends, at the east end by a structure housing a series of bins for holding molding sand and at the west end by a building in which dust arrester exhausters are installed.

Arrangement of Foundry

The foundry building, which is divided into four bays, has a total length of 490 feet 4½ inches and a total width of 164 feet 4 inches. Included in this however, is a space 60 feet wide at one end containing the motor-generator sets for the cranes, as well as the elevator, the cupolas, the charging floors, and the installation for mixing facing sand. At the other end there is a room 40 feet by 125 feet 4 inches where the castings receive a preliminary cleaning.

The foundry has a modified Pond truss roof and like the coreroom has adequate lighting, heating and ventilating facilities. The floors are composed of wood blocks and the gangways are paved with asphalt blocks.

The molding room is divided into four bays by the three rows of columns. The floors are further subdivided by a series of gangways which, like the molding floors, extend the whole length of the shop. Each molding floor is 24 by 380 feet; the center aisle or gangway is 23 feet wide, the pouring aisles, which come under the monorail, are 9 feet each, and the outside aisles next to the walls are each 12 feet 7 inches in width.

At *A* Fig. 3 is shown one of the installations for heating the building by the indirect hot-air system. Two No. 8 American sirocco blowers are provided. Each blower is driven by a 10-horsepower General Electric motor. The fan units are located near the center of the foundry which permits of a most economical and satisfactory arrangement of hot air ducts. Each unit is capable of delivering 28,000 cubic feet of free air per minute. In addition to this indirect system, the building is heated directly by steam which is supplied to a series of radiators occupying the space between the windows and the floor all around the outside walls.

Water, air and electric current are available at every other column. A 4-inch pipe line is laid the full length of the shop under the center of each floor; it is provided with 2-inch connections at 8-foot intervals which simplifies the setting up of a molding machine anywhere. Foundations for the permanent jarring machines are provided at each end of the shop. The continuous pouring system is to be employed and therefore each set of machines will be used alternately. The same idea will be carried out with the portable machines; they will travel down one side of the shop and up the other.

The castings will be shaken out and conveyed to the cleaning room on electric trucks. Bubbling fountains supplied with artificially cooled water are set up at convenient intervals, also several urinals are provided near the middle of the shop. Several 1-ton cranes with air hoists and one 3-ton Pawling & Harnischfeger crane spanning the center bays, comprise the lifting equipment. Most of the work is light and these cranes will be used principally for handling molds and pouring. A complete monorail installation will be used to distribute the iron to each bay. Four 2-ton hoists built by the Sprague Electric Crane & Hoist Co., New York, and similar to the one illustrated in Fig. 1, are employed for this purpose. In this style of hoist the operator not only drives the crane, he also tilts the ladle and fills the small ladles which are used for pouring the castings.

There are three molding sand bins, each 25 x 40 feet. The facing sand is mixed in a room situated between these bins and the cupola room. The mixing machinery, which is shown in Figs. 12 and 13, is in duplicate. Both the revolving screens have false bottoms controlled by levers. The correct amount of old and new sand and seacoal is measured out on the floor for one batch of facing and then shoveled into the screen. When it has all passed through, the lever *B* is reversed and the sand falls into a pocket from which it is carried to the upper floor by the aid of a screw conveyor and bucket elevator. Here it falls into a No. 2 Simpson pan mixer, from which it is carried by another bucket elevator to a centrifugal mixer built by William Sellers & Co., Philadelphia. It is then considered finished and drops down a chute through a hole in the floor back to a bin on the ground floor. A storage bin, 20 x 40 feet, is provided near the mixer for holding seacoal.

The four Whiting cupolas provided for melting the metal are shown in Figs. 17 and 18. Three of them are alike, with 90-inch shells lined to 65 inches at the bosh and 52 inches at the tuyeres. The fourth is 56 inches in diameter lined down to 40 inches. Each cupola is provided with two sets of tuyeres, the lower set being continuous. The charging platform is 24 feet above the ground and the spark arrester with which each cupola is crowned is 67 feet above the foundation. The concrete foundations for these furnaces are 11 feet square and 6 feet deep. It is calculated that when fully charged each cupola weighs 130 tons.

The blast is furnished the cupolas by three No. 6½ positive pressure blowers built by P. [illegible] & F. M. Roots, Connersville. Each blower is driven by an individual 75-horsepower General Electric motor. They run at 175 revolutions and deliver 8300 cubic feet of free air per minute. The three blowers discharge into a common 36-inch header. From the header, 26-inch pipes lead to each of the large furnaces and a 10-inch pipe to the small one. Blast gates are provided between each furnace on the header and again immediately before each pipe enters the windbox. Each gate is operated by a rack and pinion.

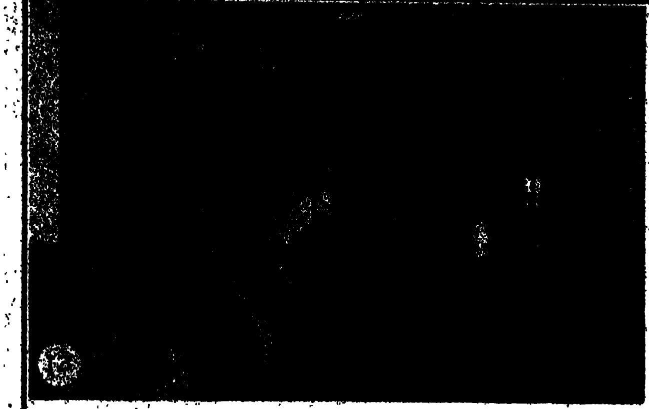
A narrow-gage industrial track with a spur running under each furnace is used for hauling away the slag and cinder from the cupola drop. Back of the cupolas, but under the same roof, is a bin for holding the clay used in daubing the furnaces and ladles, and in an opposite corner there is an oven for drying the ladles.

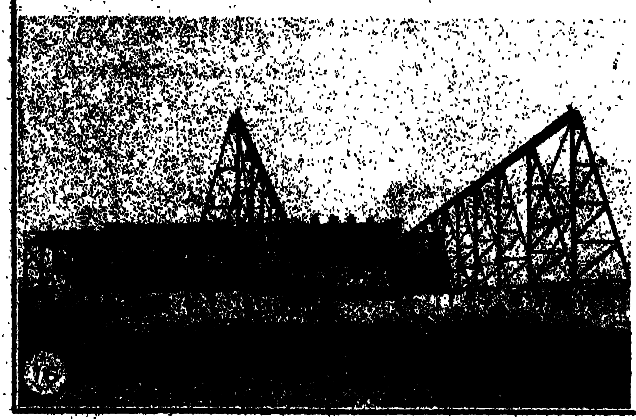
The main charging floor is shown in Fig. 15. It is provided with two Howe platform-scales and a number of bins for keeping the different kinds of iron entering into the charges separate. There is no back wall to the charging platform. A 10-ton Pawling & Harnischfeger crane with a 70-foot span hoists the charges from the stockyard shown in Fig. 16 to the charging platform, using a 62-inch magnet. This crane is also used for unloading cars and piling iron in the yard.

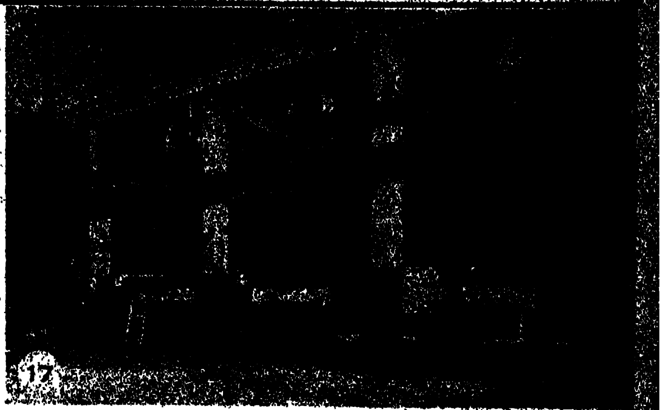
Another Charging Floor

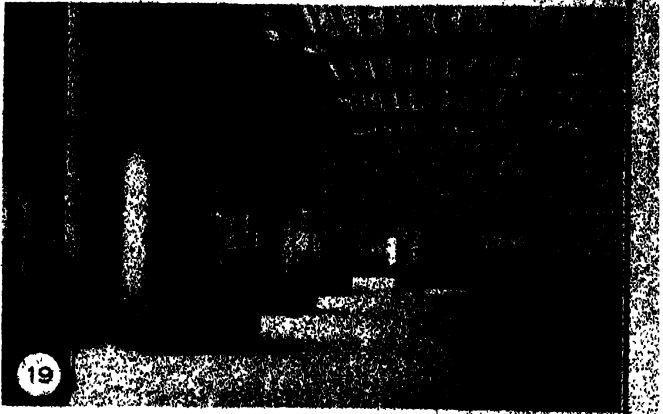
A second charging floor has been built 12 feet above the first expressly for charging sprues and domestic scrap. All the sprues, gates, etc., are brought down the north gangway by electric trucks, weighed on a Howe platform scale and taken on an elevator to the third floor. The elevator is also available for carrying charges to the main floor if anything should happen to the yard crane.

The floors of both charging platforms are made of steel plates attached with countersunk rivets to heavy I-beams and are capable of









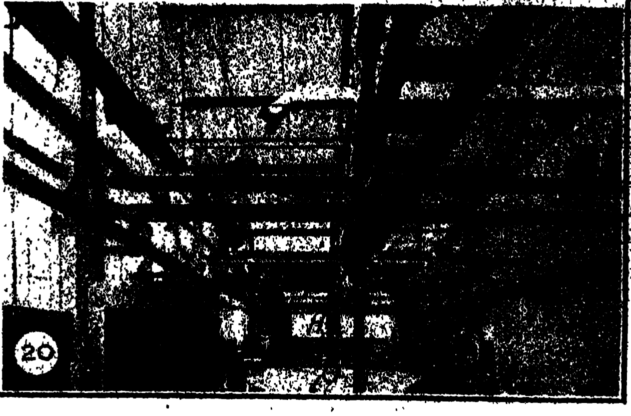


FIG. 13—UPPER FLOOR SET OF FACING-SAND MIXERS FIG. 14—CUPOLA BLOWER ROOM FIG. 15—STOCK BINS ON CHARGING FLOOR FIG. 16—CRANE RUNWAY OVER STOCK YARD FIG. 17—FRONT OF CUPOLAS FIG. 18—ARRANGEMENT OF BLAST PIPING AND CONTROL GATES FIG. 19—UPPER CHARGING FLOOR FIG. 20—PRELIMINARY CLEANING ROOM

supporting 2000 pounds per square foot. Adjacent to the charging floor a coke-storage room with a capacity of 1000 tons has been provided. The coke is discharged from the railroad cars on the outside of the building. A steel hopper provided with folding wings, which can be laid flat against the wall when not in use, guides the coke into the boot of an elevator, in which it is lifted and discharged on the floor of the storage room. This floor is on the same level with and connected to the charging platform.

A Preliminary Cleaning

The preliminary cleaning room shown in Fig. 20 is under the same roof but at the opposite end of the building from the cupolas. It is 164 feet 4 inches by 40 feet. The large cored castings, cylinders, etc., are cleaned in this room, using two sand-blast units supplied by the W. W. Sly Co., Cleveland. The cores are knocked out and the sand shoveled into hoppers in the floor, one of which is indicated at *G*, Fig. 20. A 30-inch belt driven by a 10-horsepower motor runs under the line of hoppers and carries the waste sand out through the hole in the north wall shown at *H*, Fig. 20, and delivers it into cars on an industrial track. These in turn are hauled to the dump where the sand is disposed of.

An illustration of the main cleaning room is shown in Fig. 21. It measures 281 feet 9 inches by 110 feet 6 inches. A perfectly smooth concrete floor facilitates the work of the electric trucks used for carrying the castings from one point to another. The mechanical cleaning equipment consists of one sand-blast unit supplied by the W. W. Sly Co., Cleveland, a large battery of 36 tumbling barrels built by the W. W. Sly Mfg. Co., Cleveland, and a battery of 12 double-wheel grinders made by the Norton Co., Worcester, Mass. The tumbling barrels are grouped back to back in batteries of 12; each group of six is belted to a common line shaft and driven by a 30-horsepower General Electric motor. The grinding wheels are shown in Fig. 23. The installation consists of 12 double-wheel stands carrying 4 x 24-inch wheels. They are driven from countershafts in groups of three and four by 15 and 20-horsepower motors. There is also a 4-foot surface grinder used principally for trueing the joints of the flasks used in the foundry.

The tumbling barrels and grinding wheels are attached to an elaborate dust-collecting apparatus. Individual pipes leading from each machine terminate in two large mains 36 and 42 inches in diameter respectively. These mains in turn find their outlet in one twin and two single dust arresters, each 40 feet in length and served by two Garden City double exhausters. Each of the exhaust fans is driven by an individual 100-horsepower motors made by the General Electric Co. Industrial tracks lead under the discharge pipes of the dust arrester and cars are supplied for hauling the refuse away.

The cleaning room is provided with the necessary apparatus for inspecting and testing the castings before they reach the shipping platform which is alongside the west wall of the cleaning room. The shipping department is served by a spur from the Pere Marquette railroad. Two scales are provided for checking the weight of the castings; one is a National counting scale and the other a Howe platform scale.

A supply of fuel oil is kept just west of the shipping platform in underground tanks of 10,000 gallons capacity each.

The pattern shop is a 2 story building 158 feet 10 inches by 100 feet. The lower floor is equipped with the necessary machinery for making and repairing patterns and the upper story is fitted up for a pattern storage.

The well being and comfort of the employes has been carefully considered and provided for. A building 280 feet by 80 feet 3 inches has been erected and equipped with an elaborate heating, toilet, bath and locker systems in one end; the remainder of this building is occupied by the cafeteria and foundry office.

Pittsburgh Foundrymen Start Meetings

Regular monthly meetings of the Pittsburgh Foundrymen's association for the 1919-20 season were inaugurated Sept. 15, at the Chatham hotel, with a paper by Enrique Touceda, consulting engineer, Albany, N. Y., whose subject was: "Some Pertinent Facts in Connection With Both Gray Iron and Malleable Castings." Mr. Touceda traced in interesting fashion the geology of iron, its early smelting and finally treated castings from a technical standpoint, the latter part of the talk being illustrated by lantern slides. A. M. Fulton, vice president of the Fort Pitt Malleable Iron Co., elected president of the association at its June meeting, presided, and announced the committees for the current year:

Officers and committees of the association follow: President, A. M. Fulton, Fort Pitt Malleable Iron Co.; vice president, A. J. Hartman, United Engineering & Foundry Co.; treasurer, William J. Brant; secretary, Bayard Phillips, Phillips & McLaren Co.

Executive committee: C. S. Kogh, Fort Pitt Steel Casting Co.; Henry Spilker, Sterritt-Thomas Foundry Co.; J. S. McCormick, J. S. McCormick Co.; J. Lloyd Uhler, Union Steel Casting Co.; C. F. Williams, Allen S. Davidson Co.

Program committee: G. F. Tegan, *The Iron Trade Review*, chairman; H. M. Meixner, Pittsburgh Piping & Equipment Co.; J. W. Guay, Fort Pitt Steel Casting Co; T. J. O'Brien, Fort Pitt Malleable Iron Co.

Entertainment committee. O. C. Dobson, Corborundum Co., chairman; C. W. Forcier, Mackintosh, Hemphhill & Co.; G. A. Bauman, Jones & Laughlin Steel Co.; C. L. Kirk, Kirk Supply Co.; L. W. Mesta, Mesta Machine Co.

Membership committee: L. A. Way, Lewis Foundry & Machine Co, chairman; John B. Coates, Pittsburgh Malleable Iron Co.; John Kahl, United Engineering & Foundry Co.; F. H. Clay, Allegheny Steel Co.; R. F. Eissler, Chicago Pneumatic Tool Co.; Thomas E. Reynolds, McConway & Torley Co.; Thomas Wilson, Rogers, Brown & Co

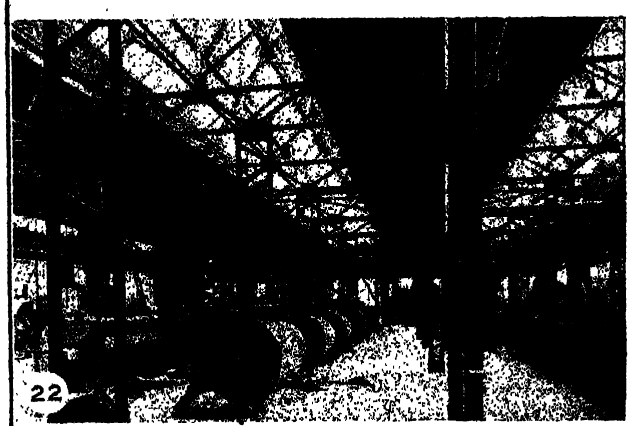
Chinese Tungsten Mines

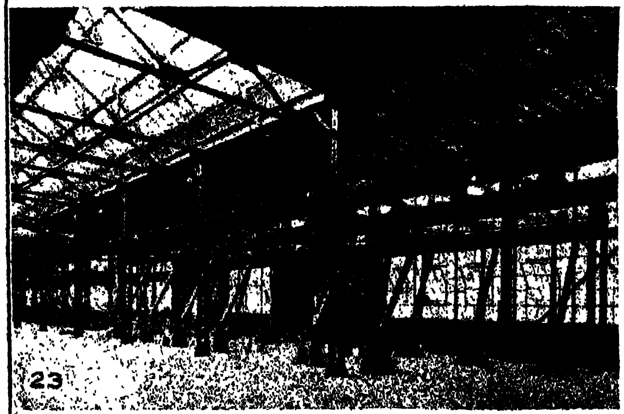
The American consul at Canton, China, in a recent report, describes a rapidly developing exportation of wolframite ore from several parts of China. When the trade in this ore began its value was not suspected by the natives, who sold it as iron ore to the Japanese at about 17 cents a pound. Now the average ore commands $32, gold, per 100 pounds at Canton. Much of it comes from Chengchow, Hunan province, and is carried on human shoulders a distance of 60 miles; then by junks 80 miles to Shiuchow; and the rest of the way to Canton by rail. Wolfram ore is said to occur at many places in Kwangtung province and also at places in Kwangsi province.

Instructions on Hoists

At a recent meeting of the Electric Hoist Manufacturers' association the engineering committee announced the preparation of a booklet entitled, "Facts for Operators of Electric Hoists." This publication is available through the secretary, W. C. Briggs, 30 Church street, New York.

The Wolff Mfg. Co. has acquired the business of the L. Wolff Mfg. Co. maker of plumbers supplies, and will extend its manufacturing facilities.





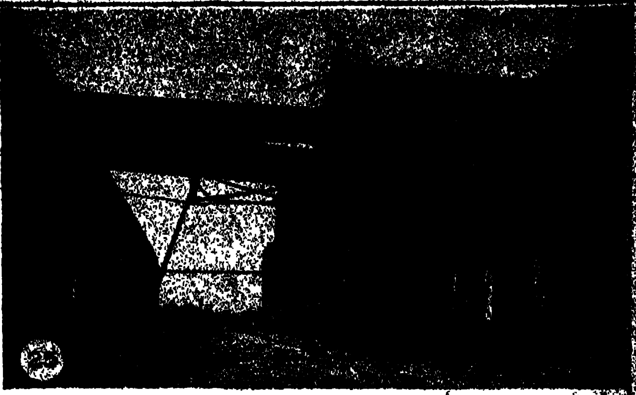


FIG. 21—GENERAL VIEW OF MAIN CLEANING ROOM FIG. 22—NOTE THE DIRECT OVERHEAD LIGHT ON THE TUMBLING BARRELS FIG. 23—THE GRINDING WHEELS ARE DRIVEN IN GROUPS OF THREE AND FOUR FIG. 24—MAIN PIPES FOR DUST ARRESTER FIG. 25—MAINS LEADING FROM THE CLEANING ROOM TO THE EXHAUSTERS FIG. 26—MOTORS AND FANS FOR DUST ARRESTERS FIG. 27—DEPRESSED TRACK AND CORE-SAND BINS FIG. 28—BOILER HOUSE AND COAL HOPPER

Bureau of Mines Laboratory Opened

Formal Dedication of the New Pittsburgh Experiment Station is Accompanied by Ceremonies Which Mark the Advance in Safety and Accident Prevention Work in Mining

MECHANICAL and mining engineers and those prominently interested in obtaining greater efficiency in the production and consumption of coal, took part in the dedication of the new million dollar laboratories of the United States bureau of mines in Pittsburgh, Sept. 29, 30 and Oct. 1. This laboratory represents the realization of a vision, the crystallization into stone and steel of the great concept of a great man who died before his work was done.

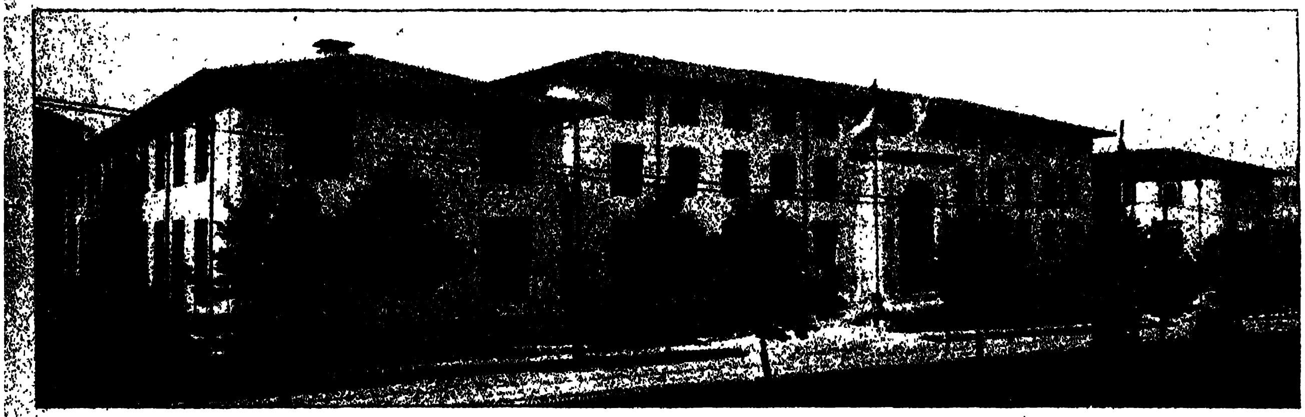
When the technical branch of the United States geological survey was organized in 1907 with Dr. Joseph Austin Holmes in charge the United States had the reputation of being not only the most prodigal nation in the expenditure of national resources, but of the lives of its citizens as well. Its leading place in the production of all the mineral substances was accompanied by a loss of life and health that resembled a vast war with the forces of nature. In 1907 there was an unusual number of mine explosions and the result was a general movement to prevent the needless loss of life. This movement culminated in the creation of the bureau of mines, for the purpose of promoting health, safety and efficiency in the mining industry.

Starting the work at Pittsburgh was a happy beginning, placing it in the center of so important a mining and metallurgical region. The bureau was housed at first in temporary and unsuitable quarters, but Dr. Holmes always kept in view a vision of a great experiment station for mining, where all kinds of accidents could be studied and methods developed for their prevention. He sought to establish a laboratory which operators and miners alike could feel was theirs and to which they could come for information and education. It was also his conception that this station should stop the waste in mining resulting from the inefficient methods employed and the excessive competition in the coal industry. To this end he foresaw the need of research laboratories for chemical and physical investigation of gases, explosives and mineral substances, the necessity of equipment for testing mine lamps and other machinery. Above all he knew that the work of the bureau would result in the training of thousands of miners in the use of rescue apparatus and in giving first aid to the injured.

The work at last is completed and the bureau of mines, in co-operation with the Pittsburgh chamber of commerce provided a program of events to fittingly commemorate the occasion. The ceremonies opened on Monday morning, Sept. 29, when the new laboratories 4800 Forbes street were thrown open for inspection. The dedicatory services were held at 10:30 a. m. on the lawn in the rear of the laboratories with Dr. Van H. Manning, director of the bureau, presiding. After invocation by Dr. S. B. McCormick, chancellor of the University of Pittsburgh an address of welcome was delivered by Hon. E. V. Babcock, mayor of Pittsburgh. Hon. Frank K. Lane, secretary of the interior, responded to the address and was followed by Horace B. Winchell, president of the American Institute of Mining and Electrical Engineers; John L. Lewis, acting president of the United Mine Workers of America, and Hon. William C. Sproul, governor of Pennsylvania. At the conclusion of the addresses Secretary Lane formally delivered the keys of the building to Director Manning.

Luncheon followed at the bureau of mines building and then the guests proceeded to the experimental mine of the bureau of mines at Bruceton, Pa., 14 miles from Pittsburgh. Upon arrival there a prearranged explosion of coal dust occurred in the experimental mine as a demonstration for the benefit of the visitors. After the explosion there was an inspection of the mine and the explosive testing plant. The guests returned to the city at 6 p. m. A general meeting was held at Carnegie Music hall at 8 p. m. under the auspices of the Pittsburgh chamber of commerce.

The new laboratories were open for inspection the entire day on Tues. Sept. 30. The elimination contests in the national safety first aid and mine rescue meet were held at Forbes field during the afternoon. A demonstration of the explosibility of coal dust was given at Forbes field at 5 p. m., and in the evening the chamber of commerce presented a pageant typifying the spirit of the mining industry. The final mine rescue contests and other events, including a pageant in the evening, were held on Wednesday, Oct. 1. The pageant consisted of symbolical figures typifying the mother earth concealing her children, which are the minerals.



NEW LABORATORY OF THE BUREAU OF MINES, PITTSBURGH, WHICH WAS FORMALLY DEDICATED SEPT. 29—RESEARCH WORK WILL BE CONFINED TO INVESTIGATION OF TYPICAL COALS AND NONFERROUS METALLURGY

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

DATA ON BELTS AND PULLEYS

By W. L. Tryon

VELOCITIES OF BELTS OR PULLEYS

(Continued from Data Sheet No. 302)

Dia. of Pulley	300	350	400	450	500	550	600	650	700	750	800	850
	Velocity of Belt or Pulley in Feet Per Minute when Number of Revolutions Per Minute Are											
11	864	1008	1152	1296	1440	1584	1728	1872	2016	2160	2304	2448
2	157	183	209	236	262	288	314	341	366	393	419	447
2½	196	229	262	295	327	360	393	425	458	491	524	556
3	236	275	314	353	393	432	471	511	550	589	628	668
3½	275	321	367	413	458	504	550	596	642	687	733	779
4	314	366	418	471	523	575	627	680	732	784	836	889
4½	353	412	471	530	589	648	707	766	825	883	942	1001
5	393	458	524	589	655	720	785	851	916	982	1047	1113
5½	432	504	576	648	720	792	864	936	1008	1080	1152	1221
6	471	550	628	707	786	864	943	1021	1100	1178	1257	1335
6½	510	595	680	765	851	936	1021	1106	1191	1276	1361	1445
7	550	642	733	824	916	1008	1100	1191	1282	1374	1466	1557
7½	589	687	785	883	982	1080	1178	1276	1374	1472	1570	1669
8	628	732	838	942	1047	1152	1256	1370	1466	1571	1675	1780
8½	668	779	890	1001	1113	1214	1335	1446	1558	1669	1780	1891
9	707	825	942	1060	1178	1296	1414	1531	1649	1767	1885	2003
9½	746	875	995	1119	1244	1368	1492	1617	1741	1865	1990	2114
10	785	916	1047	1178	1309	1440	1571	1702	1833	1964	2094	2225
10½	825	962	1100	1237	1375	1512	1649	1787	1924	2062	2199	2337
11½	903	1054	1204	1355	1506	1656	1807	1957	2108	2258	2409	2559
12	942	1100	1256	1413	1571	1728	1885	2044	2199	2356	2513	2670
12½	982	1145	1309	1472	1636	1800	1963	2127	2290	2454	2618	2781
13	1022	1191	1362	1533	1703	1873	2044	2214	2384	2555	2725	2895
13½	1060	1237	1414	1590	1767	1944	2120	2297	2474	2651	2827	3004
14	1100	1282	1466	1649	1833	2016	2199	2382	2566	2749	2932	3115
14½	1139	1329	1518	1708	1898	2088	2278	2467	2657	2847	3037	3227
15	1178	1374	1571	1767	1964	2159	2356	2553	2749	2945	3142	3337
15½	1217	1420	1623	1826	2029	2233	2435	2638	2841	3044	3246	3449
16	1256	1466	1675	1885	2094	2303	2513	2722	2932	3142	3350	3560
16½	1296	1512	1728	1944	2160	2376	2591	2807	3023	3239	3455	3671
17	1335	1558	1780	2003	2226	2448	2671	2893	3116	3338	3561	3783
17½	1374	1603	1832	2061	2291	2520	2749	2978	3207	3436	3665	3894
18	1414	1649	1885	2120	2356	2592	2827	3063	3298	3534	3770	4005
18½	1453	1695	1937	2179	2422	2664	2906	3148	3390	3632	3874	4115
19	1492	1741	1990	2238	2487	2736	2984	3233	3482	3731	3979	4228
19½	1532	1787	2042	2297	2553	2808	3063	3318	3574	3829	4084	4339
20	1571	1833	2094	2356	2618	2880	3142	3403	3665	3927	4189	4451
21	1649	1924	2199	2474	2749	3021	3299	3574	3849	4123	4398	4673
22	1728	2016	2304	2592	2880	3168	3455	3743	4031	4319	4607	4895
23	1806	2108	2408	2709	3011	3312	3613	3914	4215	4516	4817	5118

(Continued on Data Sheet No. 304)

THE FOUNDRY DATA SHEET No. 303, OCTOBER 1, 1919

DATA ON BELTS AND PULLEYS

By W. L. Tryon

VELOCITIES OF BELTS OR PULLEYS

(Continued from Data Sheet No. 303)

Dia. of Pulley	300	350	400	450	500	550	600	650	700	750	800	850
	Velocity of Belt or Pulley in Feet Per Minute when Number of Revolutions Per Minute Are											
24	1885	2199	2513	2827	3142	3456	3770	4084	4398	4712	5027	5341
25	1964	2290	2618	2945	3273	3600	3927	4254	4582	4909	5236	....
26	2042	2384	2723	3063	3404	3744	4084	4425	4765	5205	....	....
27	2120	2474	2827	3181	3534	3887	4241	4594	4948	5301	....	....
28	2199	2566	2932	3299	3665	4032	4398	4765	5131	....	....	....
29	2278	2657	3037	3416	3796	4176	4555	4935	5314	....	....	....
30	2356	2749	3142	3534	3927	4320	4712	5105	....	....	....	....
31	2435	2841	3246	3652	4058	4464	4870	5275	....	....	....	....
32	2513	2932	3351	3770	4189	4607	5026	....	....	....	....	....
33	2592	3023	3456	3887	4320	4751	5184	....	....	....	....	....
34	2670	3116	3560	4005	4451	4896	....	....	....	....	....	....
35	2749	3207	3665	4123	4582	5040	....	....	....	....	....	....
36	2828	3298	3770	4241	4713	5184	....	....	....	....	....	....

Dia. of Pulley	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000
	Velocity of Belt or Pulley in Feet Per Minute when Revolutions Per Minute Are											
2	471	524	576	628	681	733	785	838	890	943	993	1046
2½	589	655	720	785	851	916	981	1046	1112	1178	1244	1309
3	707	785	864	943	1021	1100	1178	1257	1335	1414	1492	1571
3½	825	916	1008	1100	1192	1283	1375	1467	1558	1650	1740	1832
4	941	1046	1151	1255	1359	1464	1568	1673	1777	1882	1989	2094
4½	1060	1178	1296	1414	1531	1649	1767	1885	2003	2120	2238	2356
5	1178	1309	1440	1571	1702	1833	1964	2094	2225	2356	2487	2618
5½	1296	1440	1584	1728	1872	2016	2160	2304	2448	2592	2736	2880
6	1414	1571	1728	1885	2042	2199	2357	2514	2671	2828	2984	3142
6½	1531	1702	1871	2042	2211	2381	2552	2722	2892	3062	3235	3406
7	1649	1832	2015	2199	2382	2564	2748	2931	3114	3298	3482	3665
7½	1777	1963	2159	2356	2552	2748	2945	3141	3337	3533	3731	3927
8	1885	2094	2303	2513	2722	2932	3142	3350	3560	3769	3979	4188
8½	2003	2225	2448	2670	2893	3115	3338	3561	3782	4005	4228	4451
9	2120	2356	2592	2827	3063	3298	3534	3770	4005	4241	4476	4712
9½	2238	2487	2735	2984	3233	3482	3731	3979	4228	4477	4725	4974
10	2356	2618	2880	3142	3403	3665	3927	4189	4451	4712	4974	5236

THE FOUNDRY DATA SHEET No. 304, OCTOBER 1, 1919

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

Castings for Ship Construction—X

Method of Constructing Patterns and Coreboxes for Shaft Bracket for Small or Medium Vessels — The Two Arms and the Middle Table Piece are Constructed Together

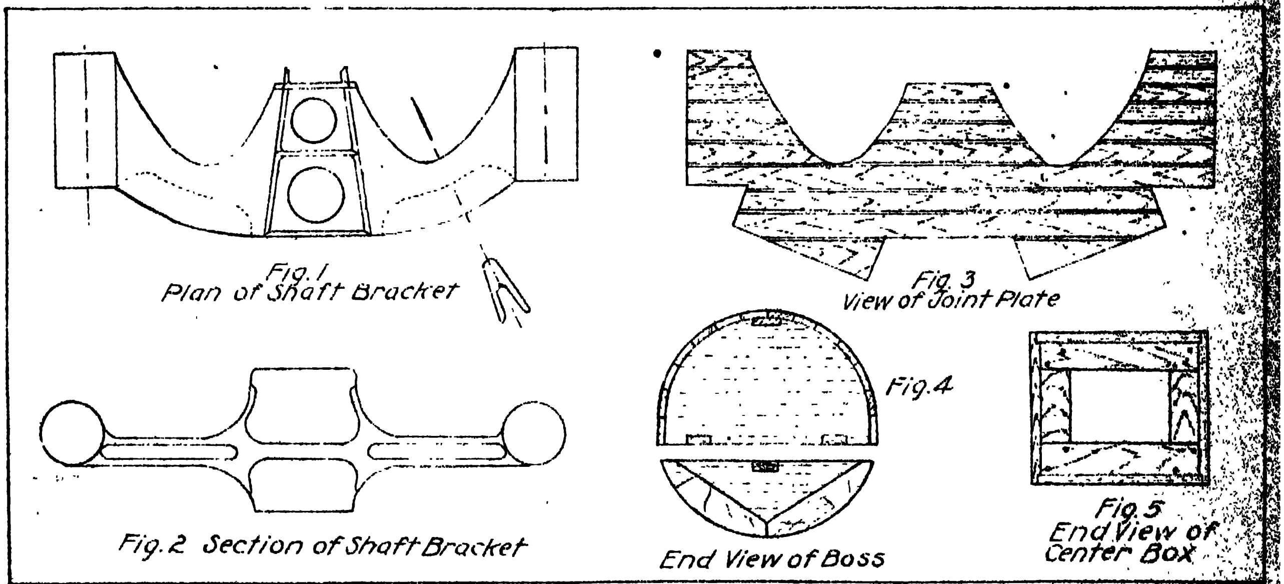
BY BEN SHAW AND JAMES EDGAR

THE shaft bracket shown in Figs. 1 and 2 is different in design from those already described. Instead of palms or flanges, the casting is usually supported by the stern frame casting and the shell plates. It will be noticed, also, that instead of two separate castings the bosses, the two arms, and the middle table piece all are one large casting. This is a form of bracket more common on small or medium size vessels. The design is equally applicable to large ships, but the casting is clumsy and difficult to make. If made for large work the center piece is split on the center line, each boss and arm being separate castings, bolted together.

The construction of the job differs materially from the palm type of bracket. It might be possible to make a skeleton pattern but this would not be profitable. It would take longer to build the curved ribs which enclose the center spaces, and which would have to be left loose, than it would to cut the large fillet on the outside from solid lumber and make coreboxes. It would also take longer to build the arms so that the molder could make a core from them, than it would to make them solid with a print and use a box. The relative quantity of lumber required in each method is important. There probably would be more timber used for a skeleton pattern, because much would be cut to waste and the coreboxes can be so made that little timber will be needed for them. However, more important than either the labor or lumber cost, is the quality of pattern produced by each method. Certainly, the solid pattern is preferred on this basis of comparison. In a skeleton pattern the heavy bosses would not be properly supported by the narrow arm end and there would be a grave danger of them breaking. Even if this did not occur the pattern might become warped in the sand with the consequent loss through an inaccurate casting. In this article, therefore the solid pattern and coreboxes will be considered.

The cores through the bosses are not shown in Figs. 1 and 2 because they are similar to those already explained, and the same methods of making the cores would be adopted. Several templates would be supplied for this job, for the arms, and also for defining the shape of the center, but the important template for the patternmaker would be that giving [illegible] contour of the bracket corresponding to Fig. 1. In all probability [illegible] would be the same as the drawing, but it might have been modified, and as usual, the pattern sizes would [illegible] taken from the templates. The [illegible] template is placed on a drawing board or on the floor and scribed around. The contraction then [illegible] added and it may be advisable [illegible] set down a section of the arm [illegible] top of this plan, and also one [illegible] two sections across the center table.

It is more convenient for the molder, if the pattern is made in two halves, the joint being through the center of the arms. It is essential that the whole pattern be built on joint plates. The patternmaker has to decide between three methods, a half lapped frame may be made, one thickness boards may be laid edge to edge and hardwood battens inset to bind them together, or a plate in two thicknesses may be built. The obvious disadvantage of the half-lapped frame is the difficulty of securing strength owing to the irregular shape. It is not possible to drive nails through from end to end. The two thickness plate is not commendable on the principle that it is bad prac-



FIGS. 1 AND 2—TWO VIEWS OF A DIFFERENT DESIGN OF SHAFT BRACKET FIG 3 VIEW OF JOINT PLATE FOR SHAFT BRACKET FIG. 4—END VIEW OF BOSS FIG. 5—END VIEW OF CENTER BOX

tice as a rule to have side grain and end grain on one perpendicular, as the side grain shrinks and the result is unsightly and troublesome in the foundry. In the present case, however, strength is the important quality to be desired in the frame as on this factor depends the rigidity of the pattern. Fig. 3 is a sketch of this plate.

The lumber should be kept the full width of the boards and left with open joints. The illustration shows the face of the plate with the lumber running the full width. The other thickness would of course be screwed across. When the plates are both screwed they may be nailed together temporarily, dowelled, and the shape set out and cut. The main the small part can be planed from solid wood. If it is rather large for this the smaller end may be made as illustrated from end grounds, with pieces screwed to them, and a stay on the face. The lagged parts can be screwed through the plate, dogs being used to hold them while turning over, or the screwing can be done from beneath.

It would not be practical to construct the center piece and both arm fillets as one piece. It must be borne in mind that the deep side of the pattern is in the bottom of the mold, therefore the print has to be on this side. No cope print is needed, as the cores are steady without one, due to the large bearing which the circular holes in the center plate at joint plate. The print should be built separately. It should be noted that in the present design the angle of the arms is uniform from the end of the large fillet which connects them with the table center to the point where they join the boss. This leaves a piece of the joint plate uncovered forming what is equivalent to a rib to the face of the boss. More often, however, the angle is lengthened so that the shape of the arms is different along the entire length, in which case it would be practically impossible to do other than make them from solid lumber, joined edge to edge. Most of the segments in this case may be lightened before being built.

The arms built as shown in Figs. 7 and 8, consist of two grounds and

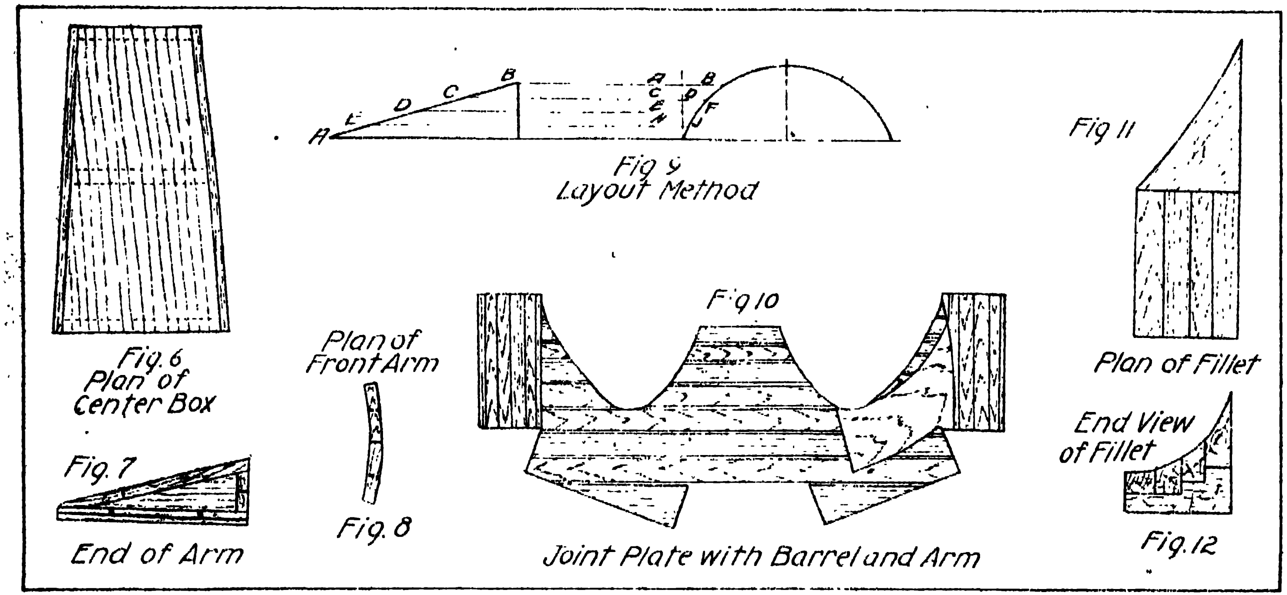


FIG. 6 PLAN OF CENTER BOX FIG. 7 END VIEW OF ARM FIG 8 PLAN OF FRONT OF ARM FIG. 9—METHOD OF LAYING-OUT THE ARMS FIG. 10 JOINT PLATE WITH BARRELS AND ARM FIG. 11 PLAN OF FILLET FIG. 12—END VIEW OF FILLET

center line and the boss centers should be squared over on both sides of the plates. The parts of the plates A-A, Fig. 3, which support the prints should be wide to balance the cores. It will be necessary to trim off the ends of the plates, after the lagged barrel pieces have been screwed to the plates, because the centers of the bosses are not on the same plane as the pattern joint. If, however, the plate is made to the finished length, it is wise to make a large part of the barrel square from the center line as shown in Fig. 4, and the small portion full the size at the outside edge so that they can be trimmed. It may be possible for patternmakers to work so accurately that no trimming of edges is necessary, but it is safer to leave a little for final finishing. The large portion of barrel is made like an ordinary full barrel with checked stays and lagging, but ford. The best way to construct the center is to make a box similar to those shown in Figs. 5 and 6. This box is made the full width of the bracket in length, and across, it follows the inside of the line of metal. Thus the small portions of the cross ribs which are carried to the outside of the metal may be nailed or wired on afterwards so that the molder can leave this in the sand until after he has drawn the main pattern.

The grounds for the box may be half-lapped frames about *2* x 4 inches, nailed together. Fig. 5 illustrates this construction. Similar boxes are necessary for both the top and bottom.

If the work is small the blocks for the arms may be made from solid wood or from thicknesses glued together. However, if the parts are large, they should be constructed similarly to those shown in Fig. 7, where a block is shown set upon the a circular segment portion on which a top plate or plates are screwed. The top plate projects a considerable distance beyond the ground at the barrel end, and the fitting shape should be cut so that when the arm blocks are laid on the joint plates, no chalking and fitting will be necessary. This is a matter of simple geometry. Two views as shown in Fig. 9 are laid out on the drawing board. The line *AB*, Fig. 9, corresponds to the angle of the arm joining the barrel. Three or four lines are projected to the front elevation and the distances *AB*, *CD*, *EF* and *HI* are determined. Fig. 10 is a plan showing both barrels and one of the arms fixed on the joint plate.

Making the fillets is difficult. If large, they are built as shown in Figs. 11 and 12, and if smaller they are glued up solid as shown at *A*, Fig. 13. With either method the blocks should be fit-

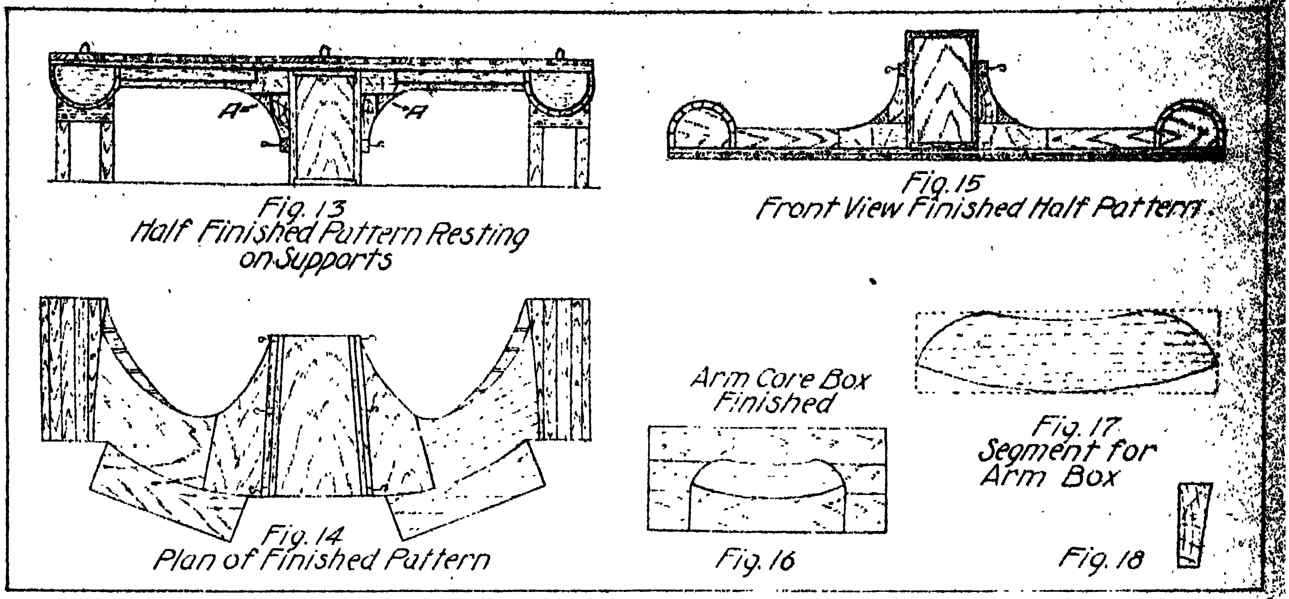


FIG. 13—FINISHED HALF PATTERN, SHOWING THE SUPPORTS FOR THE BARRELS FIG. 14 PLAN OF FINISHED PATTERN FIG. 15 FRONT VIEW OF FINISHED PATTERN FIG. 16—FINISHED ARM COREBOX FIGS. 17 AND 18 TWO VIEWS OF SEGMENT FOR ARM BOX

ted into correct position before they are cut to shape, when lines can be drawn off the arms. It is not possible, of course, to build that part of the fillet beyond the arm proper which is shown in Fig. 11.

The ribs that project beyond the ends of the center box are best left until the two halves are together to ensure their being in line top and bottom. The prints for the arms are made solid or boxed up according to the thickness. As a general rule when work is less than three inches thick, it is well to box it up. If these prints are made in this way an inch plate will do for the top with a front of the same thickness and two thicker ends. It is always good practice to make the grounds much thicker than lagging or staves because they have to take screws and also because they must be more rigid and stable. The ends are checked into the sides, that is the sides are recessed to form a shoulder, which prevents the ends from being knocked in.

The pattern now is ready to turn upside down to build the other half on top. It is not essential to build the one half on top of the other, and if sufficient men are available the two halves may be made concurrently, as long as the joint plates are made together. It is always necessary, however, to try the two halves together before the pattern goes to the molder, so that faces can be tested with a straightedge. There is also less danger of details being forgotten when the whole work is seen together. Before the halt pattern is turned over, however, supports must be provided to carry the barrels, as shown in Fig. 13. Accuracy is necessary for these supports as the joint plates must be kept straight while the second half is being built. It the pattern is built with a twist it is almost impossible to rectify it after it is finished. To safeguard against this when building such a large pattern the joint face of the completed portion should be sighted with parallel srtaightedges.

It is not necessary to say much

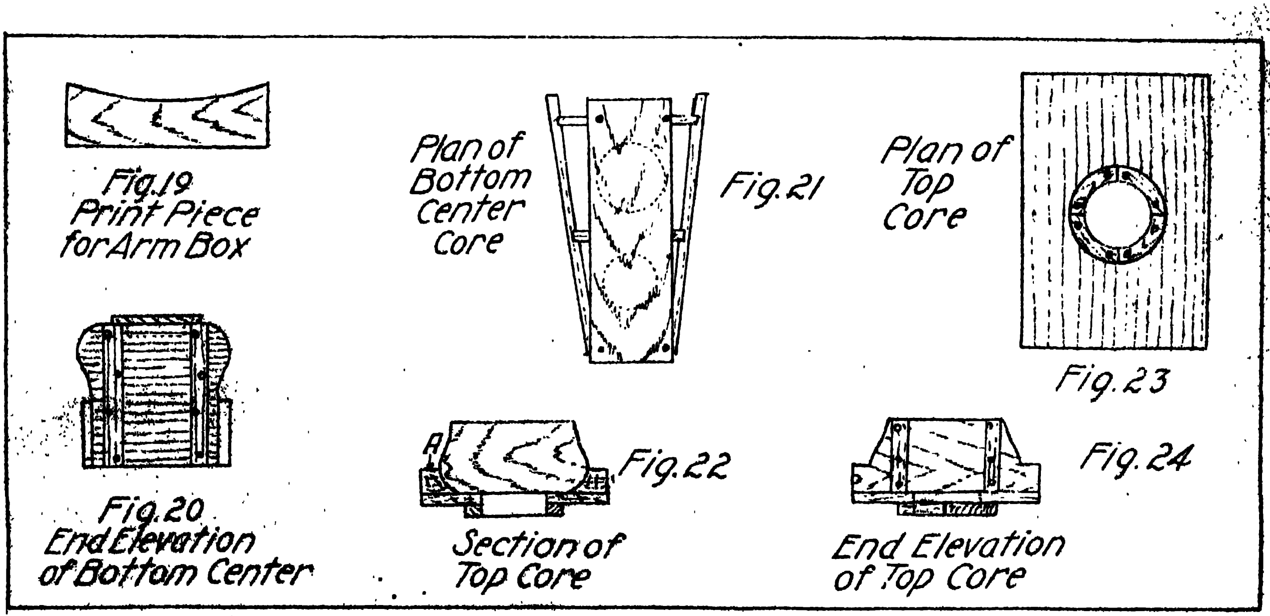


FIG. 19—PRINT PIECE FOR ARM BOX. FIG. 20—END ELEVATION OF BOTTOM CENTER CORE FIG. 21—PLAN OF BOTTOM CENTER CORE FIG. 22—SECTION OF TOP CORE FIG. 23—PLAN OF TOP COREBOX FIG. 24—END ELEVATION OF TOP COREBOX

about the second half as it is similar, although more shallow.

The center box for this half is made to the top of the ribs as no print is needed. The ribs at the end of the center table may now be screwed on. As it is possible that the molder will leave the ribs in the sand when he draws the pattern, no driving nails should be used to fasten them in place. Although they are not shown in the plan of the finished pattern, Fig. 14, or in the front elevation, Fig. 15, prints must of course be made for the ends of the barrels.

Identifying Marks

The central block in the shallow half of the pattern should be painted black or such a color as the prints are painted to signify that the core is on the outside. Much good time is wasted in the foundry measuring coreboxes to get thicknesses, which should be given by the patternmaker.

The easiest method for keeping the half pattern rigid while conveying it to the foundry, is to make two long bars about 3 x 9 inches in section, and screw them to the joint plates. In all probability the molder will leave them on the pattern while molding the bottom half.

The coreboxes are not difficult to make. They are four in number, one being necessary for the arm, and three for the table. A half box is all that is required for the arm core. Fig. 16 is a plan of this box. When the bottom plate has been made, a board at least ½ inch more than half the thickness of the print should be screwed to it, and cut to the counter of the core. If the box is made only for half the core depth, there will be a feather edge on the piece shown in Figs. 17 and 18. The taper of this piece should be planed while the timber is rectangular and the core shape afterwards drawn on it. A piece like Fig. 19, ½ inch thick completes the box. The two half cores are made and glued together in the foundry.

The table core should be made in three boxes. If it were made as one core, it would be difficult to make and would be too fragile to handle. It is really simpler to make the portions of the core above and below the middle plate separately, connecting them by a socket joint formed by placing prints in the bottom corebox, projecting circular cores being made in the top boxes. The whole of the bottom core, the core that is with the main print is undivided, but the top core must be in two parts as there is no print and a middle dividing rib must be provided. The two cores might be made in one box, but it is inconvenient in the foundry, and the small amount of extra labor involved in the patternshop, making two boxes, is well worth while. Figs. 20 to 24 give the different details in the construction of the top and bottom boxes. Boxes are not always so made in the patternshop that the molder can use his lifter without trouble. The most suitable grids also seldom are considered but they should be, and these boxes are designed with this object in view. The one style of box is as cheap as the other.

The bottom box consists of two sides and two ends, the ends being let into the sides. The sides are carried up to the beginning of the curve. It is not necessary to have a bottom on this box.

On the top and resting on the ends is a bar to carry the print. This bar should be dowelled so that it can be replaced without trouble. There is a little more work involved in making the other boxes. Bottoms are necessary and the circular holes have to be cut through these bottoms. The rings of segments on the underside of the plates are provided to save timber and make the boxes lighter. Blocks (*A*, Fig. 22) must be made and screwed to the bottom. These make the core to the center of the radius, and beyond this can be struck off in the same way. The ends of the box (*B*, Fig. 24) are made sufficiently long to enable them to be screwed to the ends. In all these boxes it is advisable to batten the ends, and it may be necessary to fit brackets against them to prevent them from being rammed outward.

Selecting Sands for Cores

Question—We would like to obtain a list of core sand mixtures covering all kinds of mixtures and for all thicknesses of metals.

Answer—It is not necessary to have such a list of core mixtures as mentioned in the query as it would lead to a lot of changing of sands and binders. When the reasons for using different sands is known it is always easy to make up mixtures to suit the class of castings being made. Two kinds of sands are used in core making; sharp sand and molding sand. The sharp sand carries off the gases better than molding sand as the latter contains alumina, is finer in grain and packs closer. More molding sand is used in the mixture for small cores because the castings must be smoother and, being small, little gas is generated. For this reason the molding sand is satisfactory as far as carrying off gas goes, and as it packs closer there are fewer openings between the grains into which the metal could flow and produce roughness on the surface of the castings.

Molding sand also forms an important constituent of cores that are made in the round, because, unless dryers are used, such cores must be handled green in transferring them from the core box to the core plate. They must, therefore, be strong before drying, and molding sand is an important factor in giving the sand strength. The binder also figures in the strength of cores made in the round. A binder which is soluble in water makes a stronger green-sand core than an insoluble binder; thus oil makes a weak core before being baked. Knowing these facts it is not difficult to select a sand mixture and binder suitable for the kind of castings specialized in. A mixture which would be perfectly satisfactory for light cores would be useless for heavy ones.

A foundry making small castings, the cores for which are mainly made in the round should select a core mixture containing considerable molding sand and a dextrine binder. If the cores are small and thin, but have to be very strong when dried, such as cores for trolley and splicer cars for overhead electric railroad work, oil is the best binder to use. There will be no difficulty about getting the cores out of the boxes and standing them on the plates, provided plenty of molding sand is used in the mixture.

For a heavy casting more sharp sand must be used. In some cases no molding sand may be mixed with it. To prevent the metal from entering the structure of the core, it must be protected by a coating of some infusible substance, such as plumbago, and the heavier the casting due to thickness of wall, the thicker must be the coating of plumbago. In some cases it is necessary to rub the coating onto the core with the fingers.

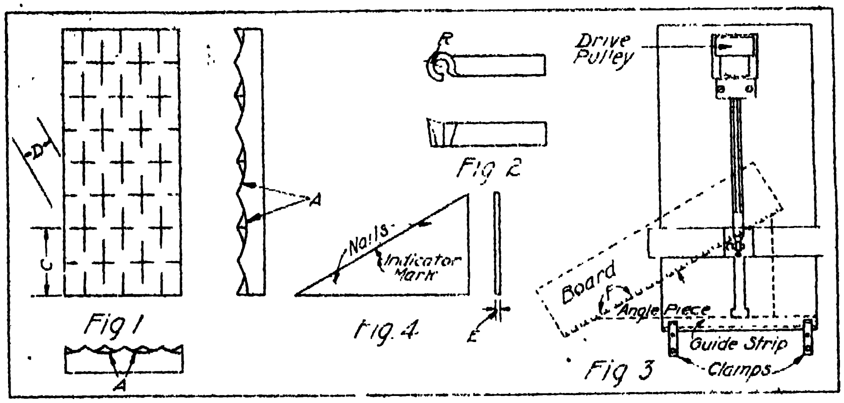
The amounts of sharp sand and molding sand in a core mixture will vary from all sharp sand to a mixture of 3 parts molding sand to 1 part sharp sand. For medium work use 1 part sharp sand to 2 parts molding sand. These are usually made up by taking 1-3 old molding sand; 1-3 new molding sand and 1-3 sharp sand, mixing and adding the binder. In the case of oil binder, use about 1 part oil to 32 parts mixed sand; flour 1 part to 10 of sand; gluten 1 part to 35 of sand; dextrine 1 part to 25 parts sand.

The Acme Silica Co., Ottawa, Ill., has opened new silica deposits at Sheridan, Ill., under direction of B. I. Larsen, general manager.

Using a Corebox Machine on Shallow Work

By William Ballantine

Notwithstanding the acknowledged efficiency of the machine which has been developed for shaping the interior of coreboxes, it is surprising to find that very few pattern shops have yet installed one as part of their regular equipment. It is still more surprising to observe the attitude of many patternmakers toward it. They seem to think it is something mysterious and therefore infinitely more dangerous on that account than any other machine used in the pattern shop. Furthermore there seems to be an impression that an expert is needed to operate it.



SIMPLE AND EFFICIENT DEVICE FOR MAKING DIAMOND PLATES

In the writer's opinion these views are entirely misleading. It is not as dangerous a machine to operate as a rip saw, and instead of an expert, an apprentice with very little instruction can turn out successfully the most difficult coreboxes. The machine not only makes a more perfect corebox than could be turned out by any patternmaker, but it does it in about 7 per cent of the time. For instance it will cut out a corebox in 20 minutes that would engage a patternmaker half a day if he had to gouge it out by hand.

The following description shows a departure from the orthodox method of using the machine and proves how adaptable it is for making a style of pattern which is fairly common in all jobbing foundries.

Some time ago we were called upon to supply a rush order of diamond plate door stills. Not having time to send to the factory for stock diamond plate it was up to us to make it. The corebox machine was suggested by the patternmaker to whom the job had been given. We tried out the suggestion and to our surprise we got a better plate than we had ever obtained by hand.

Fig. 1 shows a top, end and side view of the plate. It also shows that the bottoms of the grooves were rounded and the tops of the diamonds were quite sharp. This feature was appreciated in the foundry where the pattern molded perfectly. Fig. 2 is a detail view of the cutter used in making the grooves. The radius *R* is one-half the width of the groove. The first step was to lay out on a suitable piece of board the desired diamond, Fig. 1. This gave the angle for the jig or angle piece, Fig. 4. The jig was a piece of lumber about the same thickness as the board on which the diamonds were to be cut. It was used to hold the board at the proper angle while it was being pushed across the cutter in the direction indicated by the arrow in Fig. 3. Two nails were driven in the hypothenuse of the jig and were left projecting just far enough to keep the pattern from sliding during this operation.

A guide strip, shown in Fig. 3, was clamped across the top of the table at one end and served for a guide for the jig. The indicator marks were to show how far to move the pattern after each cut.

Fig. 3 is a view of the top of the corebox machine with the fence removed. In making diamond plate, the work is moved across the machine instead of lengthwise, as in making coreboxes. The dotted lines show the position of the guide strip, the angle piece and the pattern. The pattern was marked off on the edge *F*, Fig. 3, with dividers the same distance as *C*, Fig. 1. The board was moved one mark each time a cut was taken off. One mark was always kept at the indicator mark. After all the cuts were made one way across the board, the angle piece was reversed and the cuts taken the other way. Diamond plate made this way saved both time and money and the diamonds were all perfectly uniform in shape, size and depth.

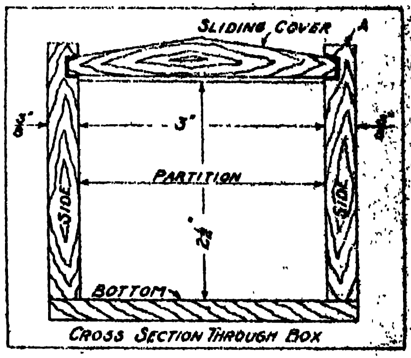
Order and System Save Patternmaker's Time

By M. E. Duggan

Brads, screws and nails are used every day in the construction of patterns. To use care in storing these supplies is considered by many patternmakers to be a waste of time. Nine times out of ten, however, those who scoff at order and arrangement are those who go every day to other departments or to fellow workmen to borrow set-screws or wire nails, because they cannot find those which they desire in their own disordered supplies.

The box which is shown in the accompanying illustration, I find to be most serviceable for holding brads or wire nails. The idea that "any old box" is good enough for nails is wrong. The careless patternmaker who has this idea is the one whose bench is a junk pile for all kinds of odds and ends. Belt lacing, leather fillets, wax, chalk, washers and jumbled packages of nails and screws litter the top and the drawers of his bench.

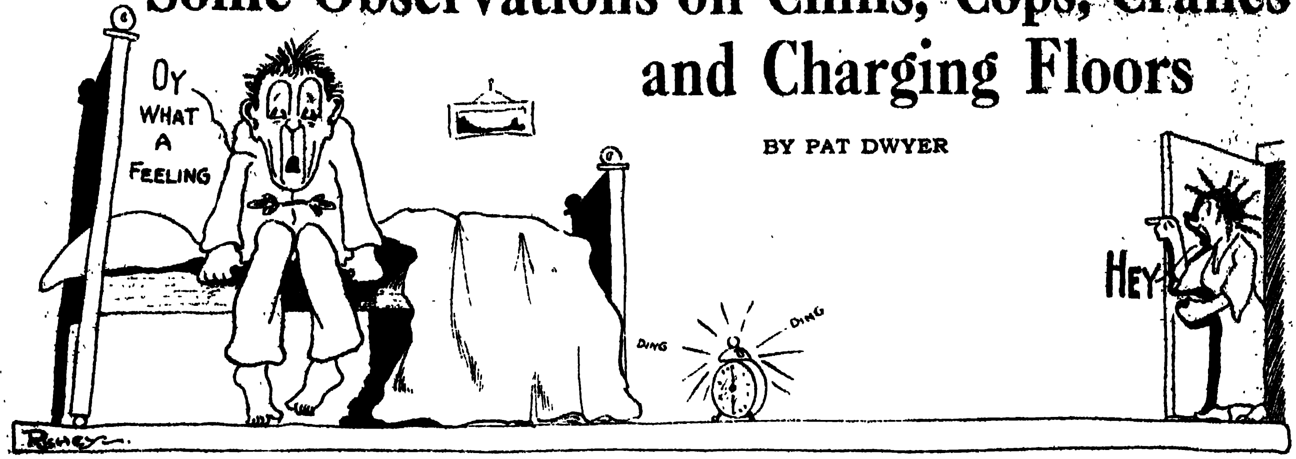
The box is 37 inches long, 3 inches wide and 2½ inches deep. It is partitioned into 12 compartments, each large enough to hold a pound of brads or wire nails. Each small box has an individual cover, except one box which is always open. In other words, there are 11 single slide covers. The size of the screws or brads contained in each box is marked on the top edge as indicated at *A*.



EASILY MADE SMALL BOX FOR NAILS, SMALL SCREWS AND BRADS

When a particular size nail or screw is wanted, the box edge indicates where it will be found. The covers then are slipped back together, allowing the one compartment to remain open, namely that which contains the size wanted. The others all are closed. If part of the nails or screws are not needed it is a very matter to drop them into the proper compartment.

Some Observations on Chills, Cops, Cranes and Charging Floors



BY PAT DWYER

ONE morning I awoke with a light head and a sore throat. I lay for a while debating whether I should get up or not. I had almost persuaded myself that a few minutes more or less would not make any difference when I commenced to sneeze. That settled the argument. A person can not sneeze comfortably in bed. If you lie on your face, you smother, and if you lie on your back, you need an umbrella. Then, too, the baby slept in a crib alongside and I was afraid I would wake her and believe me that is something else altogether.

I crept softly out of bed and putting on just enough clothes to get by the censor, I retired to the bath room to shave and sneeze as much as I pleased. I soon found that, like every other form of pleasure which is free, a little goes a long way. I finished shaving and dressing and went down stairs but found that I could eat no breakfast. My stomach felt as if it was closed for repairs, if you know what I mean, and I felt no interest in the date of reopening.

The lady who smiles at me (sometimes) across the breakfast table is a firm believer in the theory that as long as a man is able to eat he can be sent out to work; but if he cannot eat, then there is the gravest cause for alarm. "I think you had better stay home today," said she. "I will send for Dr. Squills, he will give you something to fix you up, and besides there are a few little things I want you to do around the house.

"Woman," I said, "I will stay home and I will take some of Dr. Squills essence of bitterino but I will do no work. Little I thought when I was courting a certain dimpled maid a few short years ago that she would develop into a hard hearted creature with no pity for a dying man."

She laughed at me. "I had more than dimples in those days," said she, "I had the most childlike faith and used to believe all you told me, but now—well I have never been to Missouri—but you have to show me just the same."

What could a man do with an argument like that? Nothing. That is what I did.

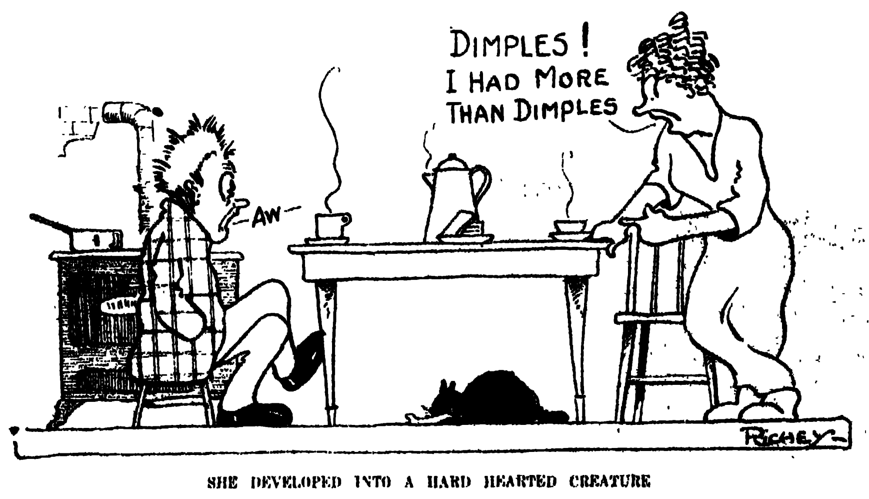
The doctor telephoned that he could not come up until the evening unless the case was very urgent. I told him I had the "flu" and if he let me die from neglect I would come back and sit on his bedpost at night and make faces at him.

"They never come back from where you are going," said he, "and besides I am never in bed at night." Then becoming serious he continued, "Do you know, I have not had a night's sleep in bed for weeks. But, I'll be out to see you this afternoon. I think from the sound of your voice that you will last that long."

I crept upstairs and into bed and for two weeks I did not care whether my name was on the payroll or not. The doctor called on several occasions and told my wife how nice she would look in widows weeds, told me that I needed to sweat a little more and I would be all right.

When I was a young man I had worked in some hot shops, I put in one summer season on the drydock in Farrel's and another closing cylinder molds in Baldwin's and I thought I knew what sweating meant. I found that perspiration and I were almost strangers. The doctor gave me a box of small tablets and whatever kind of googum was in them, they made me feel like a slice of watermelon in the hands of one of our colored fellow citizens.

I think R. Kipling must have had a flu victim in mind when he dashed off that description of the lady, you know the one I mean, "a rag, a bone and a hank of hair." That was all that was left of men when I finally got up one day and managed to get down stairs by hanging on to the balustrade. The doctor called in the afternoon and gave me the O-O and a cigarette. "Let me see you smoke that," said he, "and I can tell better what are your chances of an ultimate re-

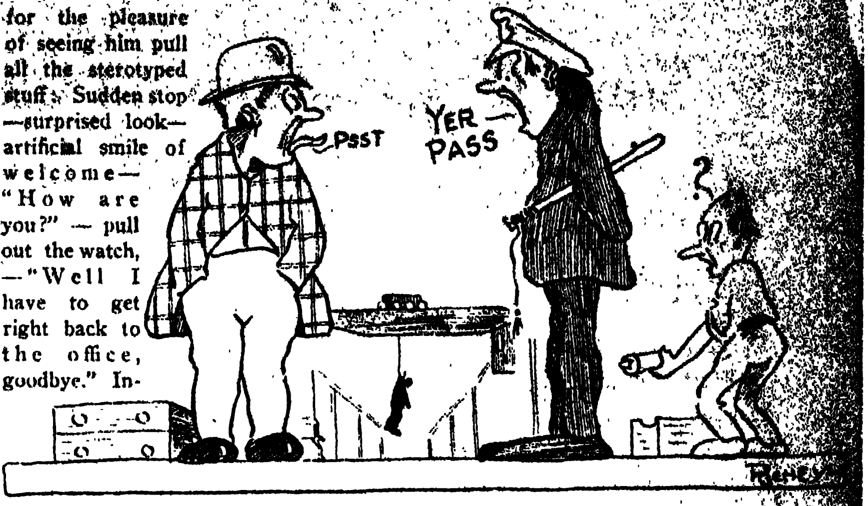

DIMPLES! I HAD MORE THAN DIMPLES
AW—
RICHEY

SHE DEVELOPED INTO A HARD HEARTED CREATURE covery." I must have convinced him that I was going to stay on this little old earth for a while for he said he would have the druggist send me out a bottle of tonic. The bottle arrived the next day. It was strong medicine and before I had it finished I was certainly a new man, but bitter—I have spent many happy hours mentally revolving fiendish forms of torture which I would like to inflict on people that I do not like but that medicine suggested new and excruciating forms of which I had' never dreamed.

The members of the family keenly enjoyed watching the contortions when I swallowed the dose, but having arrived at the age of discretion they politiely tried to suppress any evidence of great pleasure. There was one exception, a young hero about four years old. Whenever he saw me reaching for the bottle he would attract everyones attention by yelling:

"Look quick, look quick, papa is going to make monkey faces and kick his foot on the floor." It was great fun for them while the bottle lasted.

One day while convalescing I walked down the street on which Bill's shop is located and finding the door open walked in. I did not see any sign of Bill so I strolled over near the cupolas to examine a feature of the charging floor which looked new to me. While standing there the manager passed me without a sign of recognition. He was one of our modern highly developed young captains of industry, curt speech—valuable time—look at his watch every other minute—you know all that modern bunk affected by some to impress the spectator that they are full of pep and energy, regular human dynamos. I know that it sounds rude to say that many of them are filled with prunes and piffle but truth is mighty and it is a pleasure to indulge in it once in a while. I had a speaking acquaintance with him outside the shop but of course it would never do for him to recognize me during business hours. Speaking to me might mean the loss to him of 60 of those diamond seconds. I had half a mind to flag him just for the pleasure of seeing him pull all the sterotyped stuff. Sudden stop—surprised look—artificial smile of welcome—"How are you?" — pull out the watch, —"Well I have to get right back to the office, goodbye." Instead, I politely turned my back and gazed right hard in the opposite direction until I thought he was safely out of sight. While thus musing on the peculiarities of some human beings I saw one of the guards approaching at a dead-and-alive pace. I knew the fellow, in fact he had worked for me one time, so I greeted him pleasantly. Did it have any effect on him? It did not. He was swinging his billy when he approached, he now tucked it under his left arm, held out his right hand and in that insolent tone which many acquire when they put on a uniform, he ask d me if I had a pass. Just then I saw Bill approaching, I waited until he arrived and passed the case over to him.



THAT INSOLENT TONE OF UNIFORMED AUTHORITY

THE HIBERNIAN COUPE BECOMES OBSOLETE

"Personal friend of mine," said Bill to the lad. "Beat it." "He can't stay in here without a pass!" protested Authority with a capital A.

"See here," said Bill, "We ain't livin' in darkest Russia, neither are we in a penitentiary; we are in a plain American shop in a plain American town and under these circumstances when a friend of mine comes in to see me he is going to stay, pass or no pass. On your way. I don't like the way you comb your hair."

"Those are the kind of fellows who make me turn bolshivicky," said Bill to me, "they have neither brains, ambition or energy and by their laziness, insolence and assumption of authority they create a feeling of hatred in the men not only for themselves but for the company which employs them.

"The system of issuing passes to visitors is right. It discourages indiscriminate visiting. If you had gone to the office and told them that you were a personal friend of mine they would have issued a pass to you and you could have come right in. The fact that I recognized you when you appeared without a pass would satisfy any person in authority but of course this bird with the single track mind could not see it that way."

"Perhaps I had better fly while the flying is fair and open," I said; "if that hill billy comes back it may get you in bad."

"Don't worry about me," said he, "the boss may be queer but he is not crazy. He is always willing to listen to an explanation and since he convinced himself some time ago that I tell the truth whether I am right or wrong he places considerable confidence in what I say."

"There is a nice point there," I said, "whether a man is justified in making an equivocal answer sometimes, but I am in no condition to put up an argument today. I just came in to see you and to notice whether you had made any improvements in the place since I was here before."

"I should like to draw your attention to one improvement," said he, "right there in front of the cupolas."

(*Concluded on page 714*)

THE FOUNDRY

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Tell Them About It

FIFTY thousand iron molders are on a strike in Great Britain. There is no question of collective bargaining, recognition of the union or anything of that sort at issue—these problems were settled long ago in the old country, presumably to the satisfaction of the workers. The chief subject of the present controversy is the question of payment by results, in other words the piecework system. The unions demand a uniform scale, applicable alike to the good workmen and the drones. The deadening effect of such a system of wage-paying on production is obvious. We may expect some such movement in this country before long. Today piece rates are scientifically adjusted, rigidly maintained and under modern conditions, payment by results is the only just system of rewarding workers. It insures the man with superior skill and industry being paid according to his deserts; also it tends to eliminate the inefficient and the shiftless. Furthermore, the piecerate system is a powerful stimulant to production—and greater production is the key to the solution of most of our economic troubles at the present time. Employers owe a duty to their men to teach them the fundamentals of business economics so they will understand why the cost of living cannot be reduced until more commodities are produced for general consumption.

Why a Tariff?

FOUNDRYMEN should interest themselves in legislation recently introduced in the house of representatives for the purpose of increasing the duty on Ceylon plumbago, graphite ores, imported crucible clays, etc. If these bills are passed, serious cost to the foundry business will result since inevitably prices on foundry facings, crucibles, etc., would be materially increased. Furthermore, business men and international bankers who take a broad view of affairs, are concerned over the great excess of exports over imports at the present time. The only way to remedy this situation is to encourage imports of materials calculated to benefit the industries of this country. It is estimated that fully 80 per cent of the graphite used for foundry facings is imported and up to date no deposits have been discovered in the United States equal in quality to the foreign variety. There is no opportunity, therefore, under the proposed tariff, to substitute an equally good domestic article. These facts apply to high grade crucible clays as well as graphite. Foundrymen who used crucibles during the war have a vivid recollection of the troubles they experienced, and the conditions which existed then constituted no reflection on the crucible manufacturers, who in fact achieved unusual results in the face of tremendous obstacles. Now, however, when the highways of foreign commerce are again open, it would seem that the placing of a tariff on these necessary foundry raw materials would result not only in injury to the foundry industry but to our entire fabric of international trade. Under modern tariff theories, most everyone is agreed finished goods may be protected to stimulate home manufacture, but raw materials, especially when they cannot be duplicated in the home country, should be entered free of all duty and restriction in order to further stimulate domestic industry and manufacture.

Trade Outlook in the Foundry Industry

THE first few days of the steel strike found foundries in general unaffected and confident that the situation will be righted before the foundry industry is seriously interfered with through the lack of raw materials. The very fact that the first few months of the year proved lean in orders has created a reserve of iron, and the past month's revival has brought a steady buying movement that finds most plants supplied for at least a month, while many have stocks which will carry them through until the first of the year. Gray-iron shops which handle jobbing work, within the past month have experienced such an increase that in many cases several months' supply of iron has been secured and stored within their own yards.

Malleable Fortified

Malleable plants all are supplied for at least 30 days, and all those which have facilities, have stocked pig iron heavily. Malleable operations have remained steadily at about 70 per cent of rated capacity, but the steady increase in demand finds many refusing orders due to the shortage in available labor. Iron, however, has been bought to supply the high percentage operation which has been expected, and therefore the supply on hand is more than ample to care for needs through the next few months. No direct effect on the price of foundry raw materials has been noted up to the present time. Inquiries, in many cases, have been held in abeyance by northern furnaces, pending more settled conditions, and in some northern districts so few furnaces supplying foundry iron are in blast that difficulty is experienced in placing orders. Indications of a buying movement in foundry iron which seems likely to approach the high level established in July are noted in the East. The offering of 1920 iron at the price range now in force is responsible for this rush of orders. The orders placed in the Boston district during the past week have ranged from a small tonnage to 4000 tons in a single contract. Stove foundries alone have taken over 1000 tons in this district and machine-tool and special machinery manufacturers are active inquirers. The strike does not seem to have affected the market in the East to an appreciable extent.

Low Iron Production

Pig iron production in all grades, as shown by the figures of the American Iron and Steel Institute, suffered a slump during the first six months of 1919. The first half of 1918 and the last half of the same year both show greater production than does the first half of 1919. If the present rate of production is maintained throughout the remainder of the year, the total for 1919 will fall short of 1918 by 6,495,641 tons. This estimate was made before the strike introduced additional restraining influences.

The slump in blast furnace production during the first few months of the year is responsible to a large extent for the poor showing and the number of stacks blown in during July gave indication that unaffected by untoward circumstances, the last half year's would excell the first by a wide margin. Whether this will hold true will depend largely on labor conditions.

Pig iron production for the first six months by grades was as follows: Basic, 7,910,295 tons; bessemer and low phosphorus, 5,181,621 tons; foundry including ferrosilicon, 2,436,023 tons; malleable, 465,823 tons; forge or mill, 104,874 tons; ferromanganese, 106,056 tons, and spiegel, 38,136 tons. Merchant iron or iron made for the market totaled 4,499,133 tons, while iron made for the maker's use totaled 11,779.042 tons. It is noteworthy that the proportionate discrepancy between the first half 1919 production and the two six months' periods of 1918 is less marked in foundry grades than in the other classifications. This year fell behind the first half of 1918 by 182,698 tons, and lacked 190,513 tons of equalling the last half of last year. The corresponding comparison in both basic and bessemer grades shows this half year well over a million tons behind either half of last year. There was a deficiency in malleable iron production of 44,773 tons as compared with the last half of 1918 and 141,495 tons as compared with the first half of that year. As pig iron production invariably follows the demand, it is evident that with prosperity in foundry lines, these grades may closely approach the two six months periods of 1918.

Nonferrous Improves

The general upward trend in all lines of castings manufacture is particularly noticeable in nonferrous plants. The full return of automobile production has carried with it an increased demand for miscellaneous aluminum and alloy castings. The building revival has brought a great demand for hardware sundries, plumbing supplies and equipment for domestic use. A meeting of the Brass Manufacturers' association held in Detroit last week brought out the report that all brass casting plants have ample work, even beyond the limit of their labor facilities. This association is made up principally of those engaged in producing plumbing supplies. The prices of nonferrous metals have not yet been affected in any material way by the steel strike. Prices on brass foundry raw materials based on New York are: Copper, 21.50c; lead, 6.05c; tin, 54.75c; antimony, 8.50c; aluminum, No. 12 alloy, producers' price, 31.50c; and open market zinc is quoted at 7.00c, St. Louis.

Prices Of Raw Materials for Foundry Use

CORRECTED TO SEPT. 25

Iron		Scrap	
No. 2 Foundry, Valley	$26.75	Heavy melting steel, Valley	$19.50 to 20.00
No. 2 Southern, Birmingham	27.50	Heavy melting steel, Pittsburgh	20.00 to 20.50
No. 2 Foundry, Chicago	26.75	Heavy melting steel, Chicago	18.50 to 19.00
No. 2 Foundry, Philadelphia	29.60 to 30.10	Stove plate, Chicago	23.50 to 24.00
Basic, Valley	25.75	No. 1 cast, Chicago	26.50 to 27.00
Malleable, Chicago	27.25	No. 1 cast, Philadelphia	24.50 to 25.50
Malleable, Buffalo	27.25 to 29.00	No. 1 cast, Birmingham	24.00 to 25.00
		Car wheels, iron, Pittsburgh	25.00 to 25.50
Coke		Car wheels, iron, Chicago	23.50 to 24.00
Connellsville foundry coke	6.00 to 6.50	Railroad malleable, Chicago	19.50 to 20.00
Wise county foundry coke	7.00 to 7.50	Agricultural malleable, Chicago	20.00 to 20.50

Comings and Goings of Foundrymen

RALPH M. HILL, formerly with the Missouri Malleable Iron Co., East St. Louis, Ill., has been made president of the newly incorporated East St. Louis Casting Co. which will do jobbing work in light and medium gray-iron castings. John W. Eschenbrenner is secretary and Frank J. Kurrus is vice president of the new company.

W. J. Rowley has been placed in charge of the Huber Mfg. Co. foundry at Marion, O.

Fred E. Coughlin has accepted a position with the Laconia Car Co., Laconia, N. H.

John Blume formerly with the Holt Mfg. Co., Peoria, Ill., has been made assistant foundry superintendent for the Avery Co., Peoria.

Anthony Dobson has been placed in charge of a newly established branch office of the Carborundum Co., Niagara Falls, N. Y., at Detroit.

William Rohlman has resigned his position as foundry foreman for the Hoover Suction Sweeper Co., New Berlin, O.

Pierce G. Smith has been named vice president of the American Malleables Co., Lancaster, N. Y., and Owosso, Mich. Mr. Smith formerly was sales manager of the company.

H. E. McIntyre has been appointed general foreman of the new foundry of the Saginaw Products Co. division of the General Motors Corp., Saginaw, Mich.

L. E. Purnell recently has been made district manager at Cleveland for the Ajax Metal Co., Philadelphia. The new offices of the company are in the Schofield building, Cleveland.

Robert Field has resigned as foundry foreman for the Fairbanks Co., Rome, Ga., to become associated with the pig iron and coke department of that company in Cleveland.

W. J. Hughes has resigned as foundry superintendent for the H. & B. American Machine Co., Pawtucket, R. I., to take charge of the foundry of the Woonsocket Machine & Press Co., Woonsocket, R. I.

Frederick A. Stevenson formerly with the Detroit plant of the American Car & Foundry Co. has been made assistant vice president in charge of operations, with headquarters in New York.

A. A. Schneider has been assigned charge of the exports, imports and domestic sales of pig iron, manganese, chrome and other ferroalloys, coal and coke for the American Steel Export Co., New York.

William G. Hammerstrom, formerly general superintendent of the Lynchburg Foundry Co., Lynchburg, Va., has been made general superintendent for the Steel Castings Corp., Altavista, Va.

Alfred J. Saxe has been placed in charge of the branch office, established recently at 231 Insurance Exchange building, Chicago, by the Automatic Furnace Co., Dayton, O., manufacturer of automatic smokeless furnaces, chain grates, engines, etc.

Edward Smith, who formerly was foreman of the H. V. Newbigginy Pattern Works, St. Catherines, Ont., Canada, recently has accepted a position as foreman patternmaker for the Peerless Pattern Works, Buffalo, N. Y.

Joseph A. Hall has resigned as superintendent of the Tod-Booth plant of the United Engineering & Foundry Co., Youngstown, to become superintendent of the fireproofing department of the General Fireproofing Co. with headquarters and manufacturing plant in the same city.

William Turner, who comes to the United States from Canada, has been made superintendent of the foundry of the Ingersoll-Rand Co., at Phillipsburg, N. J. He succeeds Arthur Smith, who took his father's place as superintendent some time ago, but who resigned recently.

W. Edward Lindsay has been made engineer of the Lancaster Structural & Foundry Works, Lancaster, Pa., which recently purchased the plant of the Lancaster Machine & Structural Works of that city. Edgar G. Hess, formerly with the Lancaster Foundry Co. has been made works manager of the new company.

Charles P. Derleth has been made St. Louis representative for the Celite Products Co., New York City. About 14 months ago Mr. Derleth enlisted for chemical warfare service and prior to that was sales representative of the J. B. Ford Co., Wyandotte, Mich. He is a graduate of the University of Illinois.

E. Phelps Langworthy, formerly assistant works manager of the American Steel Foundry, Indiana Harbor, Ind., has been made manager of the steel castings plant of the American Radiator Co., Buffalo. G. W. Merrefield, formerly with the Clark Equipment Co., Buchanan, Mich., has been appointed assistant to Mr. Langworthy and will have charge of sales.

Auguste Griffoul who for the past few years has been foreman of the brass foundry department of Babcock & Wilcox Co., Barberton, O., has accepted a position as superintendent of foundries for the Flour City Ornamental Iron Co., Minneapolis. Mr. Griffoul's brother, Marcel Griffoul, has been made brass foundry foreman for the Babcock & Wilcox Co.

J. F. Shea recently has taken over the plant and equipment formerly owned by the Delta Foundry & Machine Corp. with which company he was employed as manager. A new partnership between Mr. Shea and his former foreman, Mr. Dixon, has been formed to operate the plant on nonferrous casting work under the name of the Marine Castings Co., 116 Fifty-seventh street, Brooklyn.

Society Will Establish Headquarters

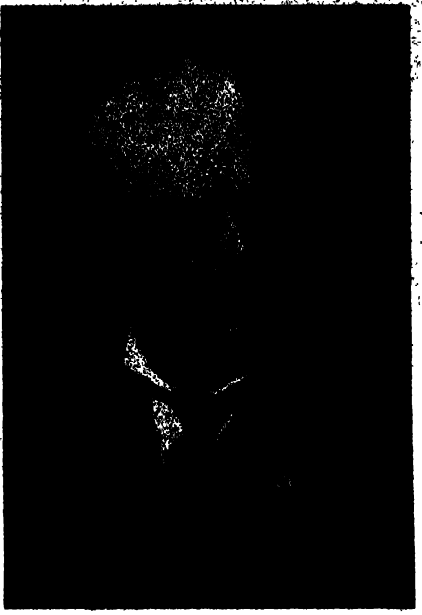
The American Society for Testing Materials has taken steps to establish permanent headquarters in the building of the Engineers' club, 1315-17 Spruce street, Philadelphia. Temporary quarters were taken up on the first floor of this building on Sept. 15, pending completion of alterations now being made on the third floor where the society's permanent home will be established. The facilities will include an auditorium on the second floor, subject to the requirements of the society, and the committee rooms, and offices on the third floor.

Observations on Chills, Cops, Cranes, etc.

(Concluded from page 711)

We walked over and he explained to me that he had carried the entire length of the charging platform out into the shop for a distance of six feet. He kept his large ladles on each end of it and on the center he dumped the shop scrap. Every morning an iron box with one end open like those used in open-hearth steel plants was laid on the floor and all the scrap from the previous day's cast piled into it. When it was filled, one of the cranes picked it up and dumped it on the platform alongside the charging door. The box was then returned, set on a truck and taken into the dog house. Here all the scrap, gates, etc., were gathered up in the same way and loaded into the box. The car was then pushed back to where the crane could catch the box which was lifted up to the platform and dumped as before. "It is quite an improvement," said Bill, "on the Irish locomotive we used to have, you know the one I mean one wheel in front and two starting bars behind."

Theodore O. Vilter



THEODORE O. VILTER

Theodore O. Vilter, president of the Vilter Mfg Co., Milwaukee, died Thursday night at his summer home on Pine lake, Wisconsin, aged 62 years He had been in failing health for several months. He was chairman of the general committee in charge of the meeting of the American Foundrymen's association at Milwaukee in 1918, and had served as president of the Milwaukee Metal Trades association and also of a Wisconsin association of ice machinery manufacturers. He was born Oct. 25, 1857, at Oldenburg, Germany, coming to America while a schoolboy. At 17 he began to earn his living as a blacksmith's helper, later serving an apprenticeship as a machinist and finally he became foreman in the shop of Peter Weisel where he started his apprenticeship. He was able a few years later to buy an interest in the company, which was known as the Weisel & Vilter Mfg. Co. In 1887 Mr. Vilter and his brothers bought the interest held by Mr. Weisel, enlarging the business and changing the name to the Vilter Mfg. Co. The company specialized in refrigerating machinery and during the war marine engines were built in quantity for the Emergency Fleet corporation. Mr. Vilter was a director of the National Foundrymen's association and the National Metal Trades association and, in addition held positions of trust in numerous Milwaukee industrial bodies.

The Damascus Bronze Co., Pittsburgh, has issued a trade publication under the title *Journal of Better Bearings*. The first number, dated August, 1919, is an attractive magazine of 10 pages. It describes the products of the Damascus Bronze Co., and in a lighter vein gives illustrations and reasons why high grade bronze should be used for bearings.

The Mt. Vernon Car Mfg. Co., Mt. Vernon, Ill., is planning a car wheel foundry to produce 700 wheels per day. Neiler, Rich & Co., Manhattan building, Chicago, Ill., are the engineers in charge.

What the Foundries Are Doing

Activities of the Iron, Steel and Brass Shops

An addition to its plant will be erected by the N. & S. Foundry Co., Seattle.

The Adler Stove & Range Co., Carnegie, Pa., has been acquired by the Keighley Mfg. Co.

The Champion Brass Works, Coldwater, Mich., has increased its capital from $20,000 to $75,000.

Erection of an addition is being planned by the Keeler Brass Works, Grand Rapids, Mich.

An addition is being erected at the plant of the Duriron Castings Co., Dayton, O.

The Union Steel Casting Co., Pittsburgh, will build a plant at 6100 Butler street.

Plans are being prepared for the erection of an addition, 100 x 250 feet, to the plant of the East Penn Foundry Co., Lehigh, Pa.

The Guerney Foundry Co., Ltd., Toronto, Ont., recently increased its capital from $750,000 to $2,000,000.

Erection of a foundry, 80 x 180 feet, is contemplated by the Pacific States Motor Truck Co., Seattle, which was recently incorporated.

The Monarch Foundry Co., Greenwood avenue and the Grand Trunk railroad, Detroit, will build a foundry, 100 x 200 feet.

A foundry, 66 x 120 feet, will be erected by the Eagle Foundry Co., Twenty-sixth street, Minneapolis.

Plans are being prepared for the erection of an addition to the plant of the Streh Castings Co., Detroit.

A branch foundry which was built a year ago by the Arneson Foundry Co., Kenosha, Wis., will be occupied in the future as the main plant, and an additional structure, 80 x 225 feet, will be erected.

The International Malleable Iron Co., Guelph, Ont., is having plans prepared for the erection of an addition to its plant, 120 x 190 feet.

The Birmingham Machine & Foundry Co., Birmingham, Ala., plans the erection of a plant addition.

The first cupola at the central foundry of the Saginaw Products Co., Saginaw, Mich., was tested out recently.

A contract has been let for the erection of an addition at the Saco Lowell Shops, Newton, Mass., to be 160 x 200 feet.

Plans for the construction of a foundry addition, 70 x 120 feet, are being prepared for the National Foundry Co., East Whitman, Mass.

Fire recently damaged the pattern shop of the Springfield Foundry Co., 3207 Smallman street, Pittsburgh.

Erection of a small addition, 35 x 60 feet, is contemplated by the National Bronze Foundry Co., Cleveland.

Contracts for the erection of a plant addition have been awarded by the Ensign Foundry Co., Toledo, O.

The directorate of the Wadsworth Foundry Co., Wadsworth, O., recently authorized an increase in capital from $15,000 to $100,000.

Paul Lemaitre, Ltd., Montreal, Que., has been incorporated to carry on the business of machinist and iron founder, with $90,000 capital, by Joseph Savage, Albert Sevigny and Emil A. Brodeur.

The Clarksville Foundry & Machine Shop, Clarksville, Tenn., is replacing a portion of its plant which was recently damaged by fire.

Gohmann Bros. & Kahler, New Albany, Ind., operating a stove foundry, are building an addition, 60 x 174 feet.

Fire recently damaged the plant of the General American Tank Corp., East Chicago, Ill., including the brass foundry, car and insulating shop.

The Malleable Iron Fittings Co., Branford, Conn., has started on the erection of an extension, 23 x 92 feet.

The Bond Foundry & Machine Co., Manheim, Pa., contemplates the erection of an addition, 25 x 150 feet.

Organization of a subsidiary company at Bath, Pa., is reported planned by the Penn Foundry & Machine Co., Allentown, Pa.

Contracts for the erection of a foundry have been let by the Montreal Locomotive Works, Ltd., 145 St. James street, Montreal, Que.

The gray iron foundry, which is under construction for the Thomas Davidson Mfg. Co., Montreal, Que., is nearing completion.

An increase in capital from $65,000 to $155,000 recently was made by the Atlas Brass Foundry Co., Columbus, O.

Two additions, 80 x 100 feet and 80 x 150 feet, will be erected at the plant of the Anderson Foundry & Machine Works, Anderson, Ind.

A movement is on foot to build a foundry at

Belvidere, N. J., for the manufacture of iron and brass castings. Oscar Smith, formerly of the Ingersoll-Rand Co., is at the head of the project.

The Iron City Foundry, Hamilton, O., is reported planning the erection of a plant addition.

Construction of an addition is under way at the plant of the Atlantic Foundry Co., Cleveland.

The Frost Mfg. Co., Kenosha, Wis., brass founder, will erect an addition to its foundry and build a new office building.

The Williams Foundry & Machine Co., Akron, O., recently awarded a contract for an addition, 60 x 145 feet.

An office building, 2-stories, 70 x 77 feet, will be erected at the plant of the Buffalo Foundry & Machine Co., Buffalo.

Erection of an addition to its machine shop and foundry is contemplated by the Slinger Foundry & Machine Co., Portage, Wis.

Bids will be taken shortly for the erection of plant additions by the Trenton Malleable Iron Works, Trenton, N. J.

The Moore Plow & Implement Co., Greenville, Mich., will build a foundry, 50 x 80 feet. F. P. Allen & Son, Grand Rapids, Mich., are engineers in charge.

The Woods Method Corp., Greenfield, Mass., has been incorporated to make castings, etc., with $99,000 capital, by Edward D. Woods, John L. Eppler and M. B. Markle.

The Gabrielson Mfg. Corp., Syracuse, N. Y., machine shop and foundry supplies, recently was incorporated with $50,000 active capital, by A. Meldrum, M. V. White and C. Gabrielson.

Plans are being prepared by Architect Henry Raeder, Chicago, for the erection of a foundry for the Maytag Co., 211 West Fourth street, Newton, Iowa.

Frank D. Chase, Inc., engineer, 645 North Michigan avenue, Chicago, is drawing plans for the erection of a foundry addition for the Ohio Steel Foundry, Lima, O.

Construction of an addition to its foundry will started soon at the plant of the E. H. Bardes Range & Foundry Co., Cincinnati. The building will be 100 x 100 feet.

William J. Thiele, Herman J. Widmar and J. M. Eastman recently were named as the incorporators of the Cambria Car & Foundry Co., Fleetwood, Pa. The company is capitalized at $50,000.

Plans have been prepared for the erection of two buildings, one 80 x 80 feet and the other 40 x 50 feet, for the Sunray Stove Co., Delaware, O.

The Gleason Works, 1000 University avenue, Rochester, N. Y., has awarded a contract to A. Friederich & Sons, 710 Lake street, for the construction of a foundry.

The May Foundry Co., capitalized at $150,000, recently was incorporated in Delaware by F. R. Hansell, Philadelphia, J. Vernon Pimm and F. M. MacFarland, both of Camden, N. J.

Contracts have been awarded by the Union Motor Truck Co., Bay City, Mich., for the erection of a plant, 100 x 500 feet and a foundry, 60 x 120 feet.

The Coppus Engineering & Equipment Co., Worcester, Mass., manufacturer of turbines, pumps, etc., is reported contemplating the erection of a brass foundry.

A plant containing more than 120,000 square feet of floor space is being erected for the Adirondack Steel Foundries Corp., Colonie, N. Y. C. W. Sherman is president of the company.

Erection of a foundry, 43 x 120 feet, and a loading platform, 66 x 240 feet, is contemplated by the General Railway Signal Co., Lincoln Park, Rochester, N. Y.

The Pittsburgh Rolls Corp., Forty-third street, Pittsburgh, is reported planning the erection of a foundry and machine shop. The company is located at Forty-first and Willow streets.

The Holmes Foundry Co., Port Huron, Mich., will begin operations in its new plant about Oct. 1. Its old plant was damaged by fire about six months ago.

William E. A. Wheeler and associates of Washington, N. J., recently were named as the incorporators of the Ray Way Foundry, Inc. The company is capitalized at $200,000.

Plans have been completed for the erection of an addition to the plant of the Pittsburgh Valve, Foundry & Construction Co., Twenty-sixth street and the Allegheny Valley railroad, Pittsburgh.

The Peninsular Brass Works, Detroit, is building a new plant, which when completed will have about 150 per cent greater capacity than its present building. A. W. Fussey is president.

The Gilson Mfg. Co., Port Washington, Wis., has awarded contracts for a foundry and machine shop addition, 80 x 160 feet. The company specializes in castings for swivel chairs and furniture, but also manufactures gasoline engines, small tractors and other machinery. Harry W. Bolens is president.

Notice of incorporation with $250,000 capital, has been filed by the Continental Castings Corp., New York. The company was chartered by H. O. Bonner, F. E. Beidler and J. J. Flannery, 149 Broadway.

G. W. Johnson, former superintendent of the Chippewa Foundry & Machine Co., Chippewa Falls, Wis., is organizing a new corporation for the manufacture of engines. A plant is now being erected.

Syracuse, N. Y., interests have organized the Catliph-Knapp Pattern & Castings Co., Inc. The company, which is capitalized at $25,000, was incorporated by William H. Catliph, John R. Sheldon, John Pickard and Charles E. Knapp.

Plans are being prepared for the erection of an addition, 105 x 120 feet, to the foundry of the Campbell Foundry Co., Harrison, N. J. When completed the building will be equipped with two cranes of five and ten tons capacity.

The Raymond Mfg. Co., New York, machine shop and foundry supplies, recently was incorporated with $150,000 capital, by H. O. Zwich, 5 Wilson court, M. Soken, 178 DeKalb avenue, Brooklyn, N. Y., and M. Cohen, 1220 Boston road.

The Lanham Cotton Cultivator Co., Empire building, Atlanta, Ga., will erect a plant to include, a machine and erecting shop, 50 x 120 feet, woodworking shop, shipping department, forge shop and foundry.

Plans have been completed for a plant for the Manufacturers' Foundry Co., Waterbury, Conn. The plant will consist of a foundry, 50 x 120 feet, a storage building, and a machine shop, 50 x 50 feet.

A recent incorporation is that of the Boyertown Brass Foundry Co., Boyertown, Pa. The company, which is capitalized at $50,000, was incorporated by W. M. Johnson, A. R. May and Garrett J. Hemes.

The Moline Iron Works, Moline, Ill., has purchased the Moline Three-I baseball park, which will be utilized as a site for a malleable foundry, 110 x 400 feet, and an enameling and finishing building, 110 x 360 feet. Construction contracts have been awarded.

According to a report the present plant of Sutton, Steele & Steele, Forney avenue, Dallas, Tex., will be greatly enlarged. The improvements will include an iron foundry. Walter L. Steele is president of the company, which was recently incorporated in Delaware with $1,000,000 capital.

Capitalized at $10,000 the East St. Louis Castings Co., East St. Louis, Ill., which was recently incorporated, has taken a lease on a building which it is now converting into a foundry for the production of medium sized gray iron castings. Practically all equipment has been purchased and the company expects to engage in active business the latter part of October. Ralph W. Hill is president.

New Trade Publications

REFRACTORY MATERIAL.—The Quigley Furnace Specialties Co., New York, has published an 8-page illustrated booklet in which a refractory plastic material for bonding fire brick and kindred uses, is described and illustrated. The booklet contains testimonials, illustrations, etc., pertaining to the use of this material in the foundry.

NONFERROUS METALS.—White & Bro., Inc., Philadelphia, have prepared a 24-page booklet pertaining to the manufacture of nonferrous metals. The latter part of the booklet is devoted to illustrations of various departments of the company's plant, and include, the laboratory, the electrolytic table, a corner of the balance room, the copper warehouse and test departments.

BLOWERS.—The Buckeye Blower Co., Columbus, O., has prepared bulletin No. 10, which describes and illustrates multi-blade fans for mechanical ventilation, forced or induced draft, mine ventilation, dry kiln where hot blast is used, waste heat installations of all kinds, mechanical systems where space is limited and exhausters. Various data are given. A chart for determining frictional resistance or static pressure in inches, water gage, is given.

SAND MIXER.—The National Engineering Co., Chicago, is circulating an 8-page booklet in which a sand mixer is described and illustrated. The mixer consists of a stationary circular pan in the center of which is located a vertical shaft, to which is keyed a central supporting casting or cross head. This casting rests on a turret in which are the bearings for the central shaft, which is operated by bevel gearing located below the machine. The supporting casting carries the plows and mullers. A lever operated door located in the bottom of the pan serves to discharge the sand from the mixer.

SWING CUT-OFF SAWS.—A 4-page illustrated circular is being distributed by the Oliver Machinery Co., Grand Rapids, Mich., in which swing cut-off saws are described and illustrated. The frames of these saws are supported by trunions which are independent of the countershafts. The frames are hung low from large screws which are supported in the hangers by means of hand wheels, permitting adjustment. The saw arbors are mounted in separate yokes which are removable from the frames and which are held in finished slots securely bolted. The arbor bearings are automatically lubricated.

BUILDING CONSTRUCTION.—A 40-page booklet designed to illustrate and explain the equipment used and the methods employed in the construction of modern buildings under a system developed by the Blaw-Knox Co., Pittsburgh, has been prepared by that company. The booklet is profusely illustrated.

TOOL GRINDER.—A 4-page leaflet has been prepared by Alfred Herbert, Ltd., Coventry, England and New York, in which an oscillating tool grinder is described and illustrated. In this grinder the grinding wheel oscillates rapidly past the tool, which is always in full view. Grinding is performed without water but a fan connected to a streamline duct in the base of the toolholder, draws all dust and chips away. The wheel spindle, self-contained countershaft, loose pulley and all shafts in the gear box with the exception of the eccentric shaft, run on oil-tight, dust-proof ball bearings.

POWDERED COAL.—The Combustion Economy Corp., Chicago, has published bulletin No. 2 in which the history and the possibilities of powdered coal as a fuel are described. Types of furnaces, draft, preparation of powdered coal for burning, storage, separation of scrap iron from coal, crushing, drying, distributing to furnaces, air supply, control, carburization and adaption to furnaces, are some of the points in the use of this fuel, which are given. A line drawing of a typical powdered coal burning system is also given.

The FOUNDRY

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Seek Economy in Repetition Work

Molding Methods Are Studied Carefully With a View to Eliminating Machine Work—Iron is Cast Around Steel Bushings to Make Bearings —Chills Are Used Extensively

TO A large degree the design of every manufacturing plant is an individual problem. This fact prevents taking a previous design and adopting it bodily when building a new foundry. The situation, shape and size of the available location all exercise a modifying and many times a determining influence on the design. Other governing factors are the amount of the daily melt, the weight and variety of sizes of the castings and the proportion of cored work; whether a large number of patterns must be provided for only a few castings on an order or whether a large number of pieces will be made from the same pattern also are questions which must receive consideration in designing a foundry. Some of these questions can be decided before the foundry is built, but frequently some of the future requirements must be estmiated on rather indefinite data. It might seem at first thought that the design of a foundry doing repetition work is simple and this probably would be true if the production of castings was the only consideration and if no attention were paid to producing at minimum cost. Attaining efficiency and low cost of operation introduce complex and interest questions when a foundry is constructed for repetition work. An example of the influence of these factors on plant design is seen in the foundry of the Hurley Machine Co., Chicago, which was built recently. About two years ago this company, which previously purchased its castings from outside sources, decided to build its own foundry The castings used are parts for electric washing machines, ironers and vacuum cleaners. None of them are heavy; the largest weighs about 100 pounds while many weigh less than an ounce. The machines are made in only a few standard types and this keeps down the number of patterns required. These standard designs are seldom changed. So that when at pattern is put into the foundry it may be used continually for a number of years. Many molders who began work with the company when the foundry was started early in 1918, are still working on the pattern which was given them at the start and some of them probably will continue to mold the same castings as long as they stay with the company. From the foregoing it may be seen that practically all the requirements for gaging the foundry output, except the amount of iron to be melted, were easily determined before this foundry was constructed. The impossibility of more than estimating

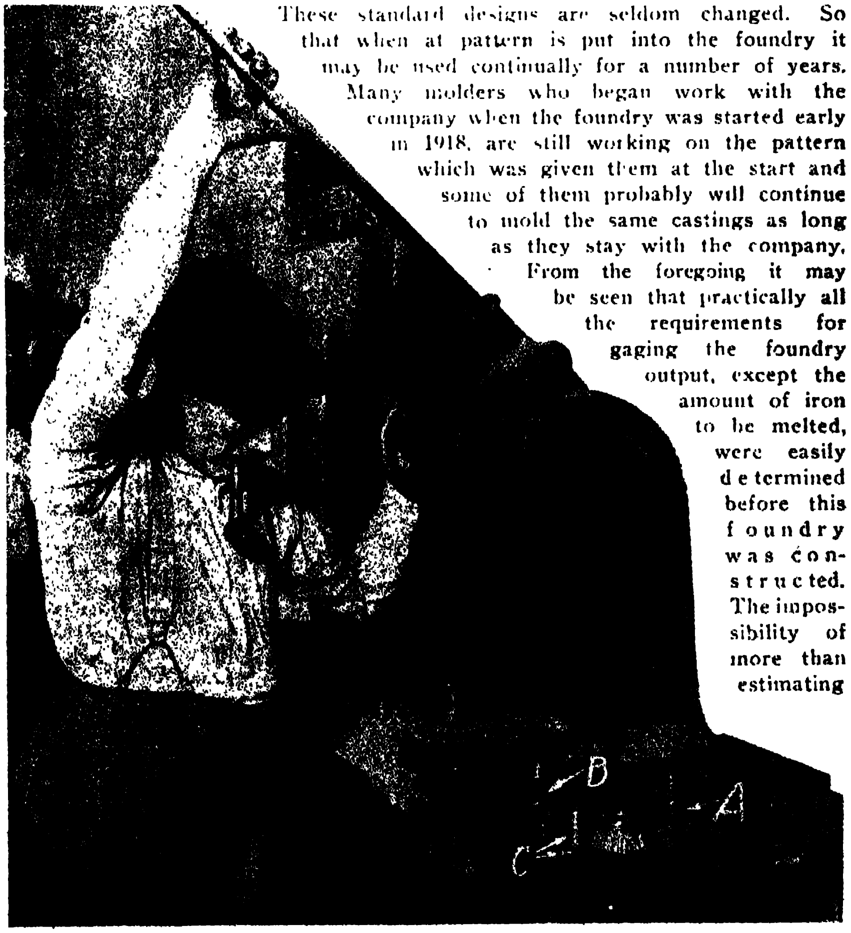
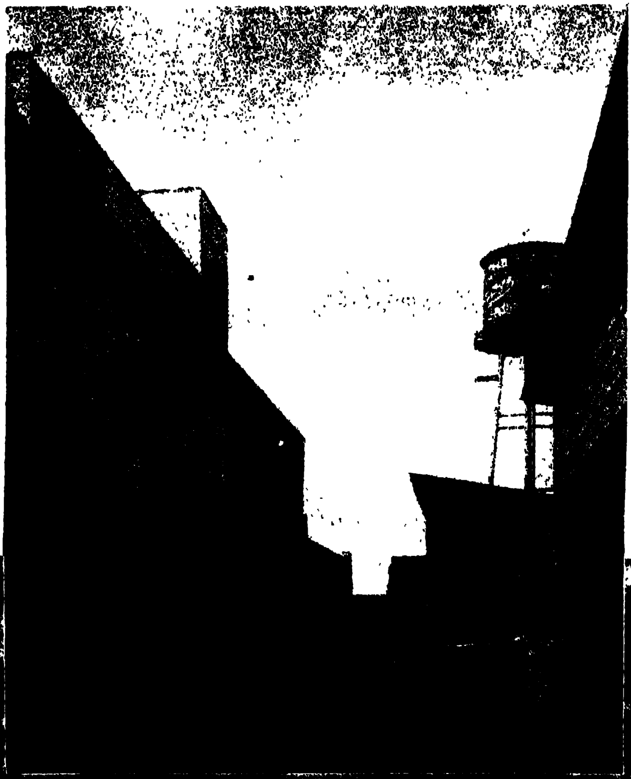


FIG. 1—PUSHING CHILL CORES OUT OF CLUTCH CASTINGS

the growth of the company's business prevented an accurate forecast of the weight of melt needed. When the foundry was started the casting requirements were only 6 tons a day. At the present time, a year and a half later, the entire capacity of the shop is being used, giving an output of 23½ tons daily.

The plan of the building is a truncated triangle. Back of the base of the triangle is the stockyard which is shown in Fig. 3. The wooden structure at the right in the foreground is used for sand storage and the frame building further on shelters the coke pile. A railroad siding running parallel with these buildings is located back of them. This arrangement allows cars to be placed conveniently for unloading. Pig iron is stored between the two buildings and on the far side of the coke-storage building. The foundry, not including the cleaning room, covers an area of approximately 23,500 square feet. About 12 per cent of this space is occupied by the cupola charging platform which is in the center of the base of the triangle and from which point a monitor roof extends along over the center of the shop On the two sides of the monitor, with the ridges running parallel to it, is a section ot saw-toothed roof. The cleaning room and stock room are in the main building opposite the charging floor. Castings are sent from the cleaning room direct to the machine shop, which is in another section of the building but adjacent to that portion containing the stock room and cleaning room. One 48-inch cupola is at present in use. The charges weighing 2000 pounds are made up of 60 per cent pig iron and 40 per cent sprues and home scrap. Mixed with the home scrap is a small amount of galvanized work which apparently does not prove deleterious in the cupola.

The pig iron and scrap are loaded upon trucks, two of which are seen standing alongside the building in Fig. 3. These are loaded with iron and weighed to the correct amount on platform scales, hoisted to the charging platform in an elevator and held there until charged into the cupola. The coke is handled somewhat differently. It is brought from storage in wheelbarrows. Each load is weighed as it passes the scales to the elevator, but when it reaches the charging floor it is all dumped on one pile until enough for the day's heat has been accumulated. The amount of coke for the bed and for each charge is estimated by the number of forkfulls which are used. This method of handling the coke has proved satisfactory. The weight used for each heat is determined accurately and the amount



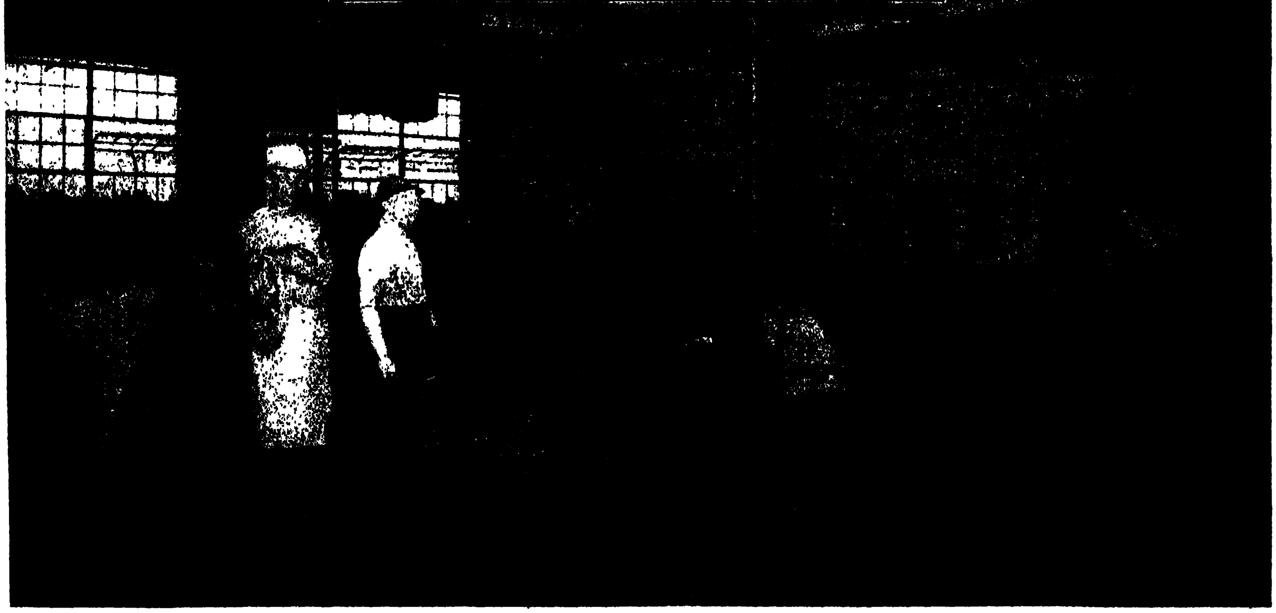


FIG. 2—CORNER OF THE FOUNDRY IN WHICH THE FLOOR WORK IS MOLDED FIG. 3—COKE AND SAND ARE STORED IN WOODEN BUILDINGS TO THE REAR OF THE FOUNDRY

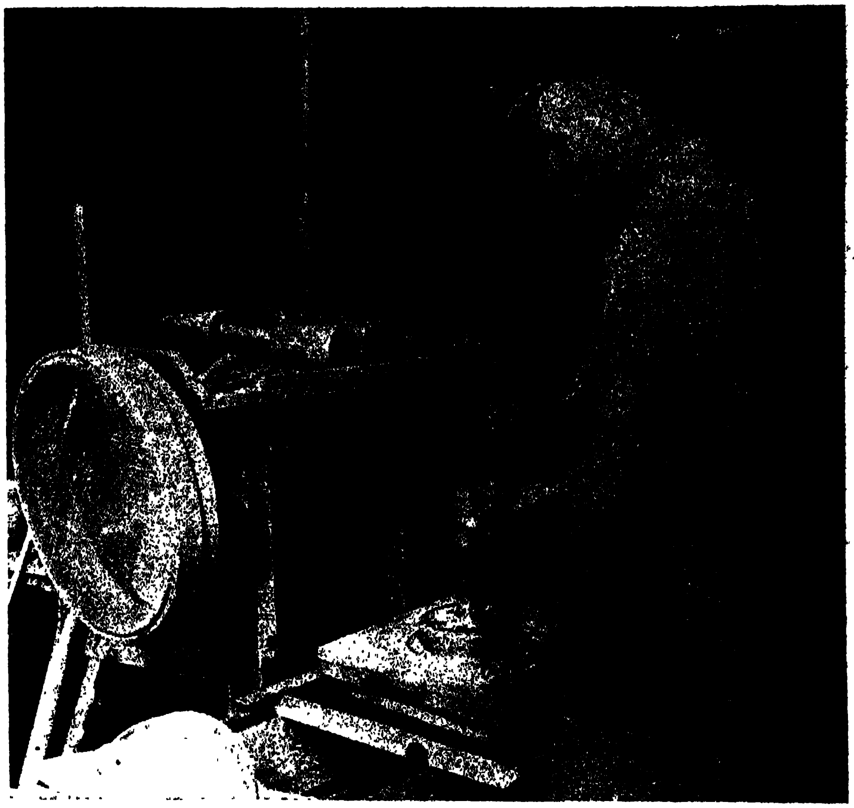


FIG. 5—A LOOSE PIECE IS USED ON THE PATTERN IN ORDER TO FACILITATE DRAWING

on each charge is gaged so closely by the man charging the cupola that there is always enough left for the last charge without there being an excess.

A centrifugal blower manufactured by the General Electric Co., Schenectady, N. Y., furnishes the blast for the cupola. It is operated by a 30-horsepower motor at 3450 revolutions per minute. A blast pressure of 14½ ounces is used.

In order to save time for the cupola operator a convenient method has been devised for cooling the refuse from the drop. A long pipe is connected with the water line and swung under the center of the cupola after the bottom is dropped. At the end of this supply line another pipe about 12 inches long is attached vertically and at right angles. The short pipe is capped so that a fine spray is distributed over the mass of heated refuse when the device is swung into position under the cupola. While the refuse is cooling after dumping the bottom doors, the cupola tender may wash up or attend to other duties, turning off the water before leaving the foundry.

The composition of the metal is checked by having an analysis made three times a week by the Charles C. Kawin Co., Chicago. This company also acts in a consulting capacity and advises regarding charging and operating the cupola and on other metallurgical problems which arise. The following composition of metal is aimed at: Silicon, 2.50 per cent; sulphur, as low as possible, usually running between 0.08 and 0.09 per cent; phosphorus, between 0.70 and 0.80 per cent, and manganese, between 0.65 and 0.70 per cent.

When the metal comes from the cupola it is carried to the molding floors in 1500-pound buggy ladles from which it is delivered to hand ladles for pouring the molds. Two of the buggy ladles are shown in Fig. 2. They are tilted by a handwheel geared to the ladle trunnions. The narrow-gage tracks on which the ladle buggies run are laid in the shape of the letter H with the cupola facing one leg of the H. The ladles are transferred from one track to the other by transfer tables situated at each junction of the cross bar of the H.

Business has increased so fast with the Hurley company that the existing capacity of the foundry is not sufficient to supply the castings required. This emergency was taken into consideration when the foundry was designed and provision was made for the installation of a second cupola to stand beside the one now in use. Another 48-inch cupola has been ordered and when it is erected a continuous pouring system will be inaugurated. This will conserve a large part of the floor space now required by the molds which accumulate before pouring begins in the afternoon, and thus room will be made for the extra molders needed for the larger output.

Under the present operating schedule half of the molders start work at 8 o'clock in the morning and the others begin a half hour later. Those who begin work first get iron at 2:30 o'clock and finish at 4:30 o'clock while the second gang is a half hour later in getting their first iron and in finishing. While the molders are waiting between ladles of iron they are not idle, but keep busy shaking out the castings they have poured and cutting the sand, so that before they leave at night the floor is in condition for them to start molding as soon as they arrive in the morning. On all floors which do not have stationary molding machines the sand is

FIG. 4—FOUR CORE OVENS BURNING ARTIFICIAL GAS FURNISH SUFFICIENT DRYING CAPACITY

FIG. 6—SOME OF THE MACHINES ON WHICH MOLDS WITH CHILL CORES ARE MADE. NOTE THE TEMPLETS AT A FOR LOCATING THE CORES IN THE MOLD

cut into long narrow piles and the benches or squeezers are started at one end of the pile in the morning and moved along the heap as the sand is made into molds.

The coremakers work in a long, narrow room at one end of the foundry. The location of this room is indicated in Fig. 4, the room being back of the windows shown and at right angles to the ovens. The core ovens are fired with artificial gas. No pyrometer is used as the ovens heat uniformly and are easy to regulate. Two of them were made by the Whiting Foundry Equipment Co., Harvey, Ill., and the others were manufactured by the Central Iron Works, Chicago. Twelve coremakers supply the cores for the 65 molders employed. The cores being small are all made with an oil binder.

Less than 20 per cent of the molds are now made on molding machines but new machines are being ordered as fast as the best method of molding each pattern is determined. At present the company has installed seven jar-ram rollover machines and five stripping-plate stands made by the Champion Foundry & Machine Co., Chicago, four squeezers manufactured by the Davenport Machine & Foundry Co., Davenport, Iowa, one roll-over machine made by Henry E. Pridmore, Chicago, and a stripping-plate machine from the Freeman Mfg. Co., Racine, Wis. Beside the machines already installed several more

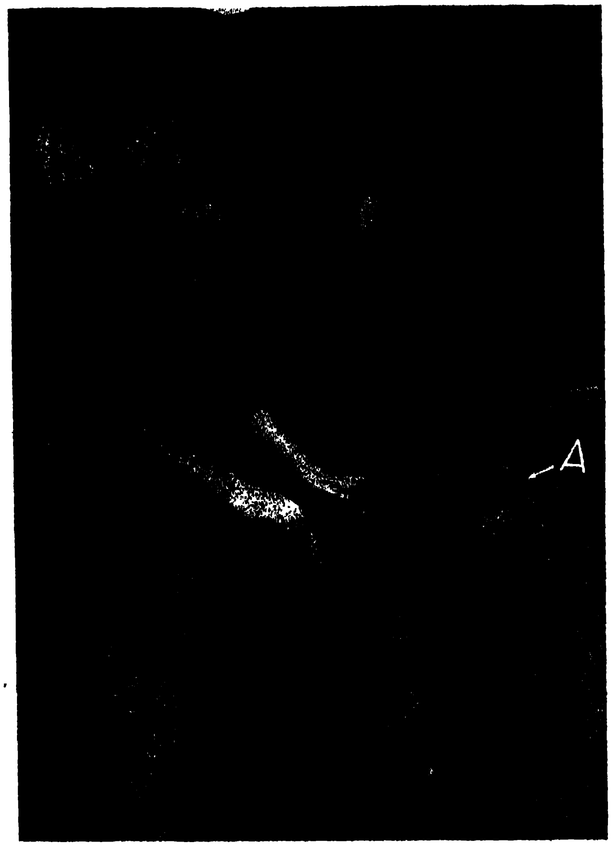


FIG. 7—STRIPPING-PLATE MACHINE IN WHICH THE HORN GATE MOVES WITH THE PATTERN

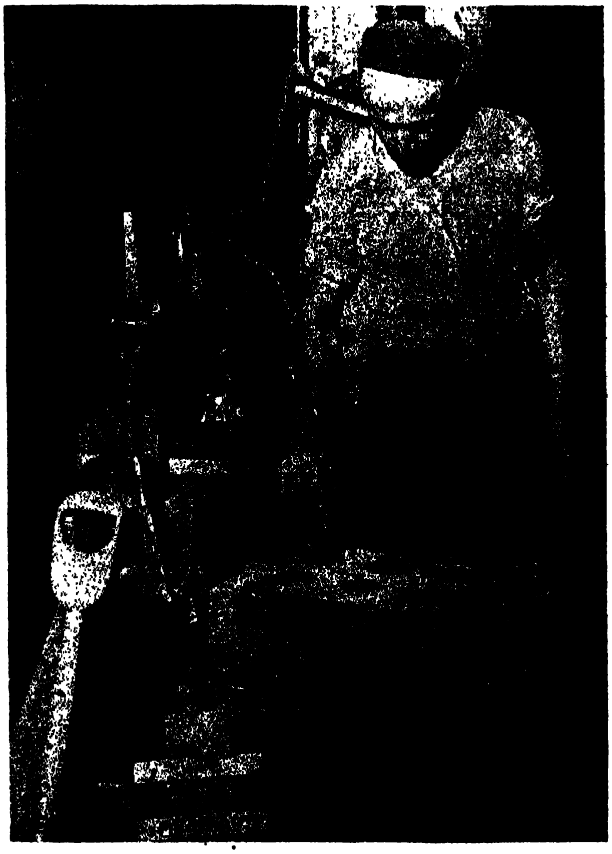


FIG. 8—PLACING THE CHILL CORES IN A MOLD

FIG. 9—THE FACE OF A COVER CASTING IS MADE SMOOTH BY USE OF A CHILL IN THE FORM OF A RING

FIG. 10—CLOSE VIEW OF ONE OF THE MACHINES SHOWN IN FIG. 6, READY TO START ANOTHER MOLD

are now on order and it is the intention of the management to have all the work made on machines within the next year.

A battery of four of the machines supplied by the Champion company is shown in Fig. 6. The machine from the Freeman company with a part of the day's work standing near it in the round flasks can be seen in Fig. 4. One of the stripping-plate stands is shown in Fig. 7. As it stands the pattern is half down and it may be noted that the horn gate at *A* is also partly lowered. This gate is drawn with the pattern by one movement of the lever.

One of the patterns which has not yet been put on a machine is shown in Fig. 5. Originally it was found that in drawing the pattern, trouble was experienced in getting a clean draw of the long, narrow end. On this account, the end piece was made separate from the rest of the pattern. In the illustration the molder is shown putting the loose piece over the projecting hub of the pattern. After the mold is rammed and the pattern drawn the loose piece remains in the sand. The loose piece is then withdrawn by the molder who places two fingers in it and turns it slightly, one way then the other, as he draws it out of the sand.

Machining Costs Reduced

All of the castings are made with the idea constantly in mind of saving as much machine-shop work as possible. One method by which machine work is avoided is by using chills which are employed in a number of instances, both in floor work and in bench work. These chills whiten the iron to a depth of not more than 1/16-inch which is not enough to be detrimental to the casting in any way.

The floor molding department occupies about 9 per cent of the area of the foundry. This department is shown in Fig. 2. The end-frame castings made from the pattern standing alongside the post near the center of the illustration are cast with chills at the ends of the legs and at the top surfaces. The portions of the castings next the chills ordinarily would require machining, but when the chills are used the casting surfaces are so smooth and true that machining is unnecessary.

Another job on which a chill is applied to good effect may be seen in Fig. 9. The pattern, in a sand match, stands to the left; on the opposite side of the molder is the cope; while the drag is on the bench before him. A circular chill similar to the one in the foreground has been placed in the drag

FIG. 11—PART OF THE SURFACE OF SOME CASTINGS IS WASHED WITH DILUTE SULPHURIC ACID TO FACILITATE MACHINING

FIG. 12—VIEW OF AN AISLE IN THE MACHINE SHOP SHOWING THE BOXES FOR HANDLING CASTINGS

and the molder is putting cores in the holes of the chill. The casting is a cover, and the chill makes a smooth, flat surface to fit against a bearing without being machined while the small cores sticking out of the chill make holes through which screws for attaching it are introduced.

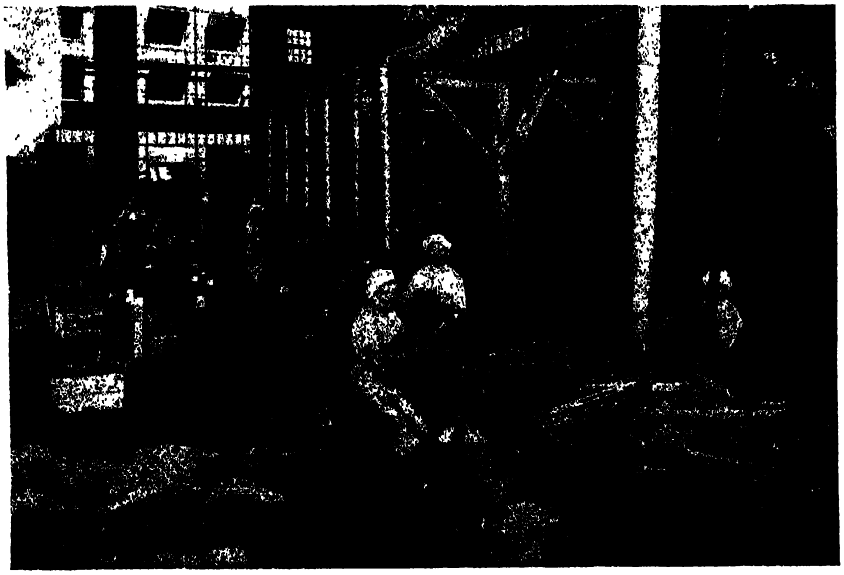


FIG. 13—WOMEN ARE EMPLOYED IN THE FINISHING ROOM WHICH IS LOCATED BETWEEN THE FOUNDRY AND THE MACHINE SHOP

Clutches are also cast with chills in order to avoid a certain amount of machine work. Many of the molds for these are made on the jar-ram rollover machines obtained from the Champion Foundry & Machine Co., Chicago. A close view of one of these machines is shown in Figs. 8 and 10. In Fig. 10 the machine is in position for placing the flask, and the pattern plate for the cope rests on the stand to the left. In Fig. 8 the drag has been made and the molder is setting the cores. Templets for truing the cores in position may be seen at *AA*, Fig. 6, and at the side of the machine in Fig. 8. The cores are kept in boards perforated with countersunk holes for holding them, *BB*, Fig. 6. One man sets the chill cores for the molds made on two machines with one molder working on each machine. These three men make an average of 173 molds a day.

In Fig. 1, George Nielsen, the foundry superintendent, is shown pushing the chill core out of a finished bevel-gear clutch casting. The assembled core stands on the bench at *A* while at *B* the core may be seen as it comes from the casting. The two pressed steel parts marked *C* are placed on the assembled core and are welded to the iron poured in the mold, remaining as part of the casting. The cylindrical piece goes through the center of the casting and forms a bearing surface which does not require machining. The round flat piece forms a collar on the beveled gear end of the casting. The heavy metal on the other end of the core chills the metal in the clutch section of the casting and gives it a smooth finish. In this way bevel-gear clutch castings which do not require any machining operations are made rapidly in large numbers. Double clutch castings are made somewhat similarly except that the pattern and the chill cores are laid horizontally in the mold instead of being molded vertically as are the bevel-gear clutches.

Another method of cutting down on machine work is shown in Fig. 11. Here a workman washes the inside surface of shoe castings for ironing machines with a dilute solution of sulphuric acid. The excess acid runs into a receiver through a hole in the floor. The acid which adheres to the castings is allowed to remain and the castings are stood up to dry as can be noted in the illustration. During the washing and drying the acid eats the surface of the casting and so cleans it. This enables the machine shop to finish the casting with one cut on the milling machine.

Girls and women are employed in the core rooms of many foundries, but in the Hurley foundry only one girl works in the core department, for cleaning cores. However, women are extensively employed in the finishing department. During the war this department was operated entirely by women, but recently female help has been more difficult to obtain and now only about a third of the employes are women.

Approximately 10 per cent of the castings are cleaned by a sandblast equipment manufactured by the Pangborn Corp., Hagerstown, Md., and the remainder are cleaned in tumbling barrels. From the tumbling barrels the castings go to the grinders and from there to the inspectors. The arrangement of these three operations can be seen in Fig. 13. The woman inspector in the foreground is looking over some bevel-gear clutch castings previously referred to in the description of molding operations. These castings must be carefully examined to make certain that the steel cylinder cast in for a bearing is smooth and has not been marred. On the bench to the front are end frames which have been cast with chills on the ends to give them a smooth, accurate finish.

The cleaning and inspection department is between the foundry and the machine shop. This location is the logical one for handling the work and makes the delivery of the castings to the machine shop convenient. In the cleaning room, the castings are loaded into boxes which run on four small wheels and are easily pushed along the floor to the machine shop.

Domestic Production of Tin Low in 1918

Tin is one of the few highly useful metals that is practically not produced in the United States proper. The output of tin from domestic ore in 1918 was only 68 tons, nearly all of it obtained from placers in Alaska.

The tin imported in 1918, as metal and in concentrates, amounted to 82,854 short tons the largest quantity yet brought into the country in any one year.

Deposits of tin ore are found in California, Virginia, North Carolina, South Carolina, South Dakota, Washington, Nevada and New Mexico, but the ore in some of the deposits contains so little tin that it cannot be mined with profit.

The concentrate from Bolivia was handled at four tin-smelting plants in this country, which produced from it over 10,000 tons of metallic tin.

A report on tin in 1918, by Adolph Knopf, has just been published by the United States geological survey, department of the interior, as a chapter of Mineral Resources for 1918 and can be obtained free of charge on application to the director of the survey at Washington.

The McLain-Carter Furnace Co., Milwaukee, has been awarded a contract by the Black Steel & Wire Co., Kansas City, Mo., for the installation of a 10-ton open-hearth furnace.

Slag Conditions in the Open Hearth

Reactions Which Take Place in the Acid Process—Names of Minerals Formed and Their Order of Freezing Given—Presence of Lime Protects Metal From Oxidation

AT A recent meeting of the British Iron and Steel institute J. H. Whiteley and A. F. Hallimond, M. A., Stockton-on-Tees, read a paper covering observations and experiments made upon the acid open-hearth process, particularly with reference to the action of the slag. The paper is divided into three sections and the following summary is given by the authors:

1.—The minerals present in slowly cooled acid slags without lime are tridymite, cristobalite, fayalite, and rhodonite; the last named contains the bases in very nearly the same ratio as the melt. The silica minerals freeze first, but supercooling always occurs to some extent. They are followed by fayalite or rhodonite, the silicate formed being determined by the ratio of iron oxide to manganese oxide; when this exceeds 73:27 fayalite is formed; in other cases, rhodonite. In slags containing more than about 8 per cent of lime, an anorthic metasilicate of CaO, FeO, MnO, MgO is obtained, which has a brilliant cleavage and gives rise to a marked acicular fracture in the slag.

2.—The order of freezing of the minerals in a number of slags whose analyses are given is represented in a ternary diagram, which is approximately that for the system $FeO\text{-}MnO\text{-}SiO_2$. A qualitative diagram is also given to illustrate the binary system $FeO\text{-}SiO_2$.

3.—Acid slags after being reheated for 18 hours at 1300 degrees Cent. contain free tridymite, and resemble the furnace hearth in structure.

4.—Spoon samples taken from the furnace are superficially oxidized to a depth which depends on the nature of the slag, and is least when the silica is high or when lime is present. The dull lustre of fractured glassy samples is due to minute particles of silica.

The Acid Hearth

5.—A number of analyses show that the hearth contains only 70 per cent of silica, although the sand used is required to contain at least 96 per cent.

6.—Microsections show that the upper layer consists mainly of interlacing plates of tridymite with interstitial slag; in the lower and cooler parts the quartz grains are less altered. The penetration of slag extends down to a well-defined limit, usually in the brickwork. The relatively small depression of the freezing point of silica in the presence of impurities is no doubt an important factor in the stability of the hearth.

7.—The effect of impurities in the sand is complex; apart from softening the bank, they give rise to caking and so prevent the absorption of the fluid slag on the bottom by the new sand—an action which is essential for the satisfactory repair of the hearth.

8.—The amount of ferric oxide in the hearth is considerably lower than that in the surface layers. This may be due to reduction by CO or metal, and to reaction with the silica present.

The Molten Slag

9.—The adjustment of the slag by the melter to the required degree of viscosity, and the manner in which the iron content is reduced by lime additions, are described.

10.—The proportion of carbon removed by gas-oxidation is estimated from experimental data for casts with and without lime additions. Between melting and tapping at least half the carbon is so oxidized, and this proportion is not greatly altered when lime is used.

11.—The physical conditions under which the molten slag reacts are discussed, and it is shown that during the boil one-half per cent of the metal is suspended as small globules in the slag, so that the reacting surface is greatly increased.

12.—The view is advanced that gas-oxidation takes place—(1) By the formation and reduction of Fe_2O_3 in the slag; (2) by direct contact of the metal and gas.

13.—Experiments are given to show that the proportion between ferrous and ferric oxides in a melt is determined by the silica content, the temperature, and the nature of the gases. In acid slag under ordinary furnace conditions the maximum, in the absence of reduction by the metal, appears to be about 4 per cent.

14.—Throughout the boil the content of Fe_2O_3 remains very low, 0.3 per cent, but may increase in the finishing period as far as 3 per cent. It is clear that the Fe_2O_3 must be very rapidly destroyed by the reducing action of the metal, which slackens as the carbon content falls and so permits the increase of Fe_2O_3 at the finish.

15.—The relative rates of various possible reactions between slag and metal are discussed. The constancy of composition of the slag in the later stages is due to a balance between the oxidation of iron from the metal, and the reduction of iron from the slag by the carbon. In an acid slag the latter reaction probably takes place mainly through the direct reduction of Fe_3O_4 rather than by the reduction of ferrous silicate.

16.—Of the carbon removed from the metal after melting, roughly one-half is removed by the ore, one quarter by gas-oxidation through the slag, and one quarter by direct contact between metal and gas.

17.—The effect of lime in the slag is to lower the Fe_2O_3 content; this action is probably of great value in protecting the metal from oxidation during dead melting.

Foundry is Reorganized

Reorganization and recapitalization of the Wheeling Mold & Foundry Co., Wheeling, W. Va., recently was completed, according to an official announcement by H. E. Field, president of the company. Under the plan of the reorganization, the holdings of the Wheeling Mold & Foundry Co. of West Virginia passed to the Wheeling Mold & Foundry Co. of Delaware. The reorganization was brought about by Mr. Field who believed that the possibilities of the company might greatly be enhanced under his personal direction, backed up by the majority control of the common stock, the preferred stock having no voting power. Since the laws of the state of West Virginia do not provide for the issue of stock of no par value, it was necessary to reorganize the company under the laws of the state of Delaware. Mr. Field, who holds 51 per cent of the common stock of the new corporation, says that the company is not to be sold to other interests as has been rumored

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Since Oct. 1 the address of the Humphrey-Mills Co., has been 202 New Telegraph building, Shelby and Congress streets, Detroit, Mich.

Philadelphia Plant Was Host

During the recent Philadelphia convention of the American Foundrymen's association, many guests availed themselves of an invitation from the Westinghouse Electric & Mfg. Co. to visit and inspect its new works at South Philadelphia, which includes a modern and complete foundry.

Foreign Foundry Practice Analyzed

Fundamental Differences in Buyers' Requirements Render a Comparison Between American and Foreign Manufacturing Methods Unfair Unless Viewpoint is Understood — Steel Castings Ascendant

BY A. O. BACKERT

SEVERAL months ago the writer returned from an extended visit to England and France where he was afforded unusual opportunities to study conditions prevailing in the foundry and iron and steel industries. The people of both countries then were still suffering from the tremendous shock of the war and the readjustment of their industrial activities to a normal status was beset with many difficulties and problems that seemed almost insurmountable. Their national debt, which exceeds per capita many times that of the United States and the depreciated value of their money as measured by the dollar standard are causes for great concern among manufacturers and financiers. Otherwise conditions generally are not unlike those confronting us today. To provide an income for the great army of workers precipitated out of employment with the sudden termination of the war, a scheme of out-of-work pay was resorted to in the United Kingdom. Originally intended as a temporary, expedient to tide over these workers, it threatens to become a permanent bonus for idleness at a weekly cost to the government in excess of $5,000,000. During the months of May and June more than 1,000,000 men and women were given this support from the national treasury and notwithstanding the tremendous shortage of labor in the metalworking industries, the number obtaining government support is increasing rather than diminishing.

Production Kept Down

In the United Kingdom the demobilization of the army was speeded up to a higher rate than in France. The return of millions of these men to peace-time pursuits, particularly those who have been out of touch with civil life for from four to five years involves difficulties that time alone can solve. In a comparatively limited degree, we too are familiar with the self-discipline involved in the transition of our soldiers from army to civil life and this, in only small measure conveys the situation existing in the United Kingdom and France.

It has been the prevailing practice of investigators of industrial conditions abroad to make invidious comparisons of production as compared with that of the United States. From the standpoint of tonnage and per capita output, particularly in the metal trades, these comparisons are borne out by statistics. However, there must be some underlying reasons for the wide divergence in these figures and more than a cursory examination revealed the causes. It has been pointed out frequently that restraint of output is the brake upon all industry of the United Kingdom and that with its removal production could be speeded up to equal that of this country. Attention also has been directed to the lack of labor-saving equipment and the need of mechanical appliances to increase output.

Difference in Buyers' Standards

A more than superficial investigation of the foundry industry of the United Kingdom discloses the effect of the restraint of output, which, however, was removed during the closing years of the war and has not again been invoked. Mechanical appliances are not in such widespread use in the casting industry as in this country. Yet many plants are modernly equipped throughout and their practice is equal to the best prevailing in the foundries of the United States. Then what are the underlying causes for the differences in the rates of production? Why is the tonnage per man for shops engaged in similar work so much greater here than in the United Kingdom?

The wide divergence in the standards of the casting buyers of the two countries is one of the underlying reasons. The insistence upon high quality and superfine finish are two requirements that slow-up production abroad. The widespread use of dry sand molds in the United Kingdom and also in France, to provide the necessary finish demanded by the trade, is a large factor in reducing the per capita output. Quality and finish have been carried to the extreme and at the sacrifice of quantity. In the shops in this country, on the contrary, green sand practice prevails and quantity production is the goal to be attained, frequently at the expense of finish and quality. That a happy medium between the extremes of quality and quantity would serve the purpose cannot be denied, but years of education in one direction cannot be diverted to another course without an equal amount of training.

Repetition work in this country is one of the factors underlying large production and it lends itself admirably to the application of all kinds of mechanical and labor-saving devices. With us it is not unusual to make 50,000 castings from the same pattern and in the automobile trade this total frequently is exceeded. Dealing in large numbers of the same unit enables the American foundryman to equip for quantity production and he requisitions for his use the most modern mechanical devices available to increase output and reduce cost. In the United Kingdom and France, repetition work is not nearly so prevalent as in the shops of the United States. Quantity production of commodities is not appreciated in the same degree as over here, nor is the need for it nearly so great. Until this year quantity was not a great factor in the motor car industry abroad, and even today the largest output of the automobile plants of both of these countries is dwarfed by the annual production of many of our motor car manufacturers. Before the war, it has been stated that the total pleasure car needs of France was only 30,000 per annum. When this number is divided among many builders it becomes apparent that repetition work among French casting manufacturers cannot be developed to a very high degree.

Lack of Standardization

In addition, the lack of standardization in many of the engineering lines reduces repetition work to the minimum. Even the railroads are counted among the violators of standards in equipment and the whim of the designer too frequently is the altar upon which quantity production is sacrificed. It has been stated that manufacturers of sanitary ware in the

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Abstracted from the presidential address of A. O. Backert at the opening session of the Interallied Foundrymen's Convention and Exhibition, Philadelphia, Sept. 30.

United Kingdom have patterns in their vaults for several thousand different designs of bathtubs and it is not unusual for an architect to enhance the beauty of his creation by individually designed tubs. Thus, the lack of repetition work may be assigned to a multiplicity of orders for small numbers of castings from different patterns and this plays havoc with production. Long runs from single patterns lead to production economies largely effected by the use of molding machines, whereas small orders for castings from a variety of models retard the installation of mechanical molding appliances, reduce the output and are a factor in maintaining the uneconomical practices of the jobbing shop.

To the comparative lack of repetition work in both the United Kingdom and France must be assigned the prevalence of the jobbing shop and the large number of small foundries, willing, even if not equipped for the production of castings in iron, brass or steel. However, this semijob work is not without its compensating features. It has a tendency to develop skilled molders, whereas our specialty shops train men to one operation, not one of whom could make a parting or cut a gate by hand. Notwithstanding these handicaps, the mechanical equipment of many of the foundries of the United Kingdom and France measure up to the best practice prevailing in this country. And the foundrymen of these countries are alive to the progress that is being made in casting manufacture over here. They are anxious to increase their production and to reduce their costs and to attain these ends they are preparing to install labor-saving equipment on an extensive scale.

Steel Casting Manufacture

Steel casting manufacture in the United Kingdom was greatly accelerated by the war. The output in 1918 totaled 276,518 tons, of which basic steel was only 10,564 tons as compared with 265,954 tons of acid castings. This tremendous predominance of acid over basic steel, which is in striking contrast to the practice prevailing in this country, must be attributed, to a large extent to the insistence of the army and navy ordnance departments for castings made by the acid in preference to the basic process and also, in a measure, to the available ores. The war also speeded the installation of electric furnaces for the production of steel for castings. At the time of the armistice, 37 were in operation in foundries with an actual output of more than 5000 tons per month and 11 additional were being installed which will increase the actual production to 7000 tons per month.

When the war was terminated, electric steel casting production was at its height in the United Kingdom, as indicated by the output of 46,637 tons in 1918 and compared with 108,296 tons for the United States in the same period. Of the total steel casting output of the United Kingdom in 1918, the electric process accounted for 17 per cent against 7.7 per cent for the United States, indicating a production in proportion to the total steel casting output more than twice as great as that of this country.

A further analysis of the steel casting statistics for both countries in 1918 reveals striking differences in practice. Steel for casting purposes made in converters in the United Kingdom exceeded open-hearth production by 1936 tons, the former having totaled 116,231 tons against 113,630 tons for the latter. In the United States, on the contrary, where the open-hearth process predominates, the production of converter steel last year was 160,844 tons as compared with 1,140,830 tons of open-hearth steel. In the United Kingdom converter steel represents 42 per cent of the output as contrasted with 11.3 per cent in this country and open-hearth only 41 per cent against 80 per cent in the United States. Among the converter processes employed in the United Kingdom the Tropenas leads with 53,633 tons; the ordinary side-blow process is second with 48,858 tons and the Stock, oil-fired converter is third with 13,075 tons. Classified as basic converter steel is 665 tons. No records of the production of steel castings by the crucible process in the United Kingdom are available, and statistics of last year's output in the United States indicate also that this process is passing in this country. Statistics of the steel casting production of the United Kingdom and the United States for 1918, follow:

	United Kingdom Tons	United States Tons
Acid open hearth	103,731	634,950
Basic open-hearth	9,899	505,880
Converter	116,231	160,844
Electric	46,657	108,296
Crucible	......	1,330
Miscellaneous	......	110
Total	276,518	1,411,410

In many of the English plants the combined installations of cupolas and converters are unique. For the purpose of eliminating the handling of the metal in ladles from the cupolas to the converters, the melting furnaces are located on platforms at a considerable height above the floor level to permit of tapping the iron direct from the cupola spout into the mouth of the converter. Troughs are provided for directing the metal into the mouth of ether converter, one being located on each side of the cupola.

Following the curtailment of ordnance buying and the cancellation of existing contracts in November last year, many electric furnaces in steel foundries were shut down and the production this year will show a material decline in the United Kingdom. This is due to the high cost of manufacturing this grade of steel and the comparatively limited demand for electric steel castings for commercial purposes.

Book Review

Foundry Practice, a text book for molders, students and apprentices, by R. H. Palmer; cloth; 390 pages, 5 by 8 inches; published by John Wiley & Sons, Inc., New York, and furnished by THE FOUNDRY for $3.00 net.

The second edition of this book has just been published, much of the text has been rewritten and subject matter has been added. The additions include a description of the rigging and flasks and details the processes of securing and pouring molds to produce large propeller wheels economically. Other new matter in this edition deals with the patterns, flasks, cores, molding, setting and securing cores, gating pouring, and testing the iron for locomotive slide valve cylinders. Additional information also is given on casting locomotive superheater cylinders, casting lathe beds and chilling the ways, making cores for gasoline engines and cylinders, and molding large kettles.

As in the previous edition this book goes thoroughly into the question of molding in its every phase. Greensand molding is considered first, and methods are described for molding irregularly shaped patterns including gears. Pit molding, floor molding and bench molding also are described. Dry sand work and loam molding are fully detailed. After the subject of making and setting cores is finished, the questions of molding machines, sand and metallurgy of iron are presented. Under metallurgy might be classed the chapters on iron and its composition, the treatment of castings while cooling, mending broken castings, and the chapter on the cupola and its operation. In the back of the book is a glossary giving definitions of foundry terms and a number of tables containing useful data for the foundryman.

The S-T Engineering Corp., Buffalo, has been incorporated with a capitalization of $100,000 to manufacture and sell mechanical equipment.

How to Care for Foundry Equipment

In Order to Get Anything Like Adequate Production From Labor Saving Machinery It Must be Looked After Intelligently, Lubricated Freely and Given a Fair Trial

BY G. L. GRIMES

A MOTOR car has to contend with the dust of the road, it operates under far better conditions than obtain in the average foundry where dirt and grit attack the bearings of equipment. Most men make it their business personally to see that their automobiles are oiled, but how many give as much thought to the care of their foundry equipment?

It is generally expected that there will be a large exodus of foreign labor and probably comparatively little immigration. The second generation of foreign labor does not care to go into the foundry but prefers the machine shop. The decrease of labor and the increased demand for better and larger output, combined with the growth of the idea of the conservation of material and resources, forces the foundryman to face new conditions; he must develop new methods and processes and make up for the shortage of men by the installation of more machinery. The addition of machinery brings with it the problem of maintenance.

Manufacturers realize that they have made an investment for capital account when they buy a lathe or milling machine for the machine shop. They install it in a clean, well lighted shop. Each operator is required to keep his own machine clean and many shops allow special time for this purpose. Machinists are trained to oil their own machines, and a man is made responsible for oiling the lineshafts and motors. A tool room, with the best mechanics in the shop, is usually provided to repair the equipment when it breaks down.

Foundry Machinery Often Neglected

But this policy does not seem to hold true in regard to foundry machinery. In many cases, the machinery is purchased, and no more attention is paid to it as long as it runs. The foundry process is a dirty one. The sand and dust that flies when the molds are being shaken out covers everything in the foundry, and many foundrymen act as if it is useless to attempt to keep machinery clean. When installing equipment, many neglect to provide a proper place for it. Think of installing a motor driven air compressor in the dust of the cleaning room! But it is done.

Some foundrymen allow the night gang to shovel the sand back covering the molding machines so that the operators have to dig them out every morning. This delays production and damages the machines.

A steel foundryman called the manufacturer of his sand mixer and claimed it would not work properly. The equipment manufacturer found that the main bearing had not been oiled and the brass was nearly worn out, yet the foundryman wanted it replaced free of charge.

If an automobile begins pounding and the garage man has to put in new rods or bearings, the owner does not expect him to replace the parts and throw in the labor because the machine was purchased from him.

The change in foundry methods caused by the introduction of machinery is calling for mechanical training that was not necessary with the old floor methods. Too many foundrymen depend on their hunches that the equipment is all right or not. Often when foundry superintendents and foremen are changed, the entire equipment is changed. This is an economic waste which reacts seriously on the industry. Equipment is often condemned when it only needs a little intelligent care.

Many foundries buy equipment for certain work and when that is completed, the equipment is taken out into the back yard and allowed to rust. When it is needed again it is found to be ruined. A little care in covering it up and slushing with grease would save thousands of dollars every year.

Others, when their molding machines are out of service, allow bottom boards, old shoes, shirts and all sorts of trash and dirt to accumulate on them. When a job comes that could be run on the machine, it is too much bother to dig it out.

The logical and cheapest way to reduce the foundryman's worry is to hire a competent master mechanic or upkeep man to look after the mechanical details of the equipment in the foundry, as is done in rolling mills, machine shops, paper mills, etc.

Fully 95 per cent of the trouble with foundry equipment is due to improper lubrication. Where it is possible heavy grease should be used on revolving shafts as it will form a collar of grease outside the bearing, making the finest dust protector possible. On some sliding surfaces on handrammed molding machines, ordinary plumbago or facing makes an excellent lubricant as the sand does not stick to it. One superintendent experimented with different oils on his molding machines and found that the fuel oil used in melting furnaces washed the sand out of the sliding surfaces and had enough body to properly lubricate the surfaces.

Novel Method Insures Oiling

The complaint is heard that the men do not seem to take the interest in their work they formerly did. In order to have some check on the man in care of machines, one foundry has installed a watchman patrol system with a key at every important bearing, machine and motor. The oiler carries the clock, which he must ring at every station. By this clock record, the superintendent at least knows that the oiler has visited each place.

When a molding machine is out of service in this plant, it is cleaned up and boxed to protect it from dirt. The boxes are arranged to be easily taken apart and stored when not in use.

An automobile foundry realizes that the operators do not take care of the machines or patterns properly, so when the day's work is finished, one man blows off, cleans and oils the molding machines. A second man cleans the patterns and puts a tarpaulin over the machine so the dust will not get into the machines. These measures insure that the machines will be ready next morning for the scheduled production.

Enlarges Malleable Shop

The Link Belt Co. is making an addition to its Belmont foundry at Indianapolis, in order to take care of increasing demands for malleable iron chains. The new building will be about 70 x 400 feet. The company intends eventually to install two furnaces in this building, but at present only one furnace is being erected. This furnace will be of 15 tons capacity instead of 10 tons like the present furnaces. Additional foundry equipment to handle the increased melt is being purchased and installed.

Abstract of paper read at the twenty fourth annual convention of the American Foundrymen's association held at Philadelphia Sept. 29-Oct. 3. The author, G. L. Grimes, is president of the Grimes Molding Machine Co., Detroit.

Making Castings for Giant Lathes

Mammoth Machine Tools Required for Machining Huge Guns Demanded Exceptional Skill in all Processes — Precision Attained in Castings for Super-Gun Lathes

SOPHISTICATED as we are to the stupendous numbers and mammoth machinery of the great war, receiving each new revelation of engineering accomplishment with expressions of admiration grown meaningless through reiteration, it is doubtful if any clear perception of details is registered. We read of the hundreds of ships, the thousands of guns, the millions of rifles and the billions of grenades which were made, and focus upon these items which are only the measure of accomplishment. Grouped behind these visual markers which serve only to gage the tremendous force of modern war is an infinite power of shop activity which the mind does not readily conceive. Few indeed are those who think back of the finished engine of war, and analyze the factors which went to make it.

It is difficult to appraise at true value the great amount of preparation which goes into equipment necessary to manufacture war munitions. Each truck, each gun, each tank or tractor represents a cumulative effort starting with the design and construction of the tools to build it, and often this preliminary work in itself is stupendous.

Consider one of the largest naval guns, ponderous and imposing, but finished to the ultimate of precision. The engineering skill and workmanship upon it is evident. It represents a definite accomplishment which is apparent even to the casual observer. But greater than the gun itself is the tool by which it is machined. In the April, 1918, issue of THE FOUNDRY a description was presented covering some of the main castings made for special gun lathes. The machines mentioned were described as 102-inch gun lathes, some of a number ordered from the Niles works of the Niles, Bement, Pond Co., Hamilton, O. It now is possible to present some further details concerning these lathes, and the foundry problems connected with building them. Over two years ago the navy department ordered four of these great machines for boring large guns. These were specified as 102-inch swing. Later 11 lathes with 120-inch swing were ordered and finally a repeat order was placed for four of the latter size mentioned. This work has engaged the main efforts of this great foundry continuously for almost two years. A drawing of one of these mammoth machines—the world's largest lathe—is reproduced, Fig. 2. It may be noted, that the main castings required are the headstock base, the cap-casting for the headstock, the bed sections and the boring-bench sections. On account of their size, intricacy and the imperative need for perfect surfaces where machined, the production of these castings involves interesting foundry practice.

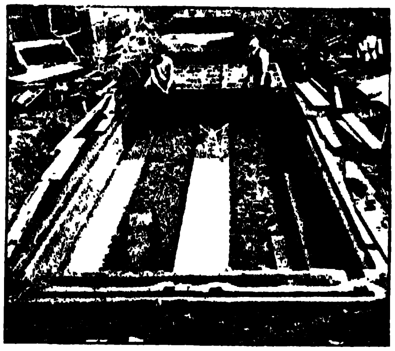


FIG. 1—RAMMING THE LAST OF FOUR PARTS OF A BED SECTION—NOTE THE CHECKS LOCATING THE SEGMENT PATTERN AT A

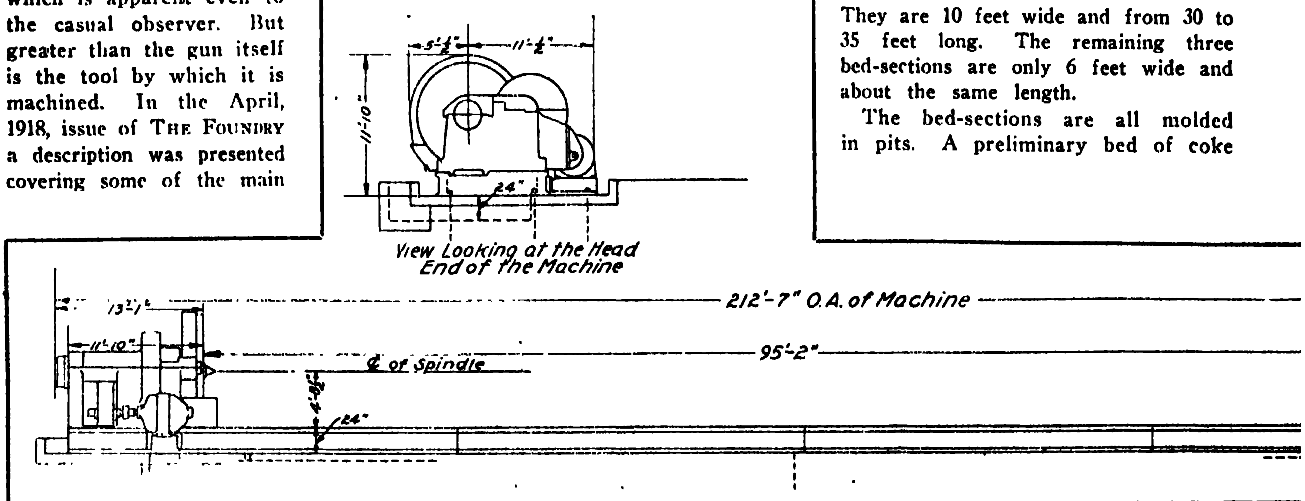


FIG. 2—NO ADEQUATE CONCEPTION OF THE GREAT SIZE OF THE LATHES CAN BE GAINED FROM A MERE DRAWING—SEVEN LONG SECTIONS ARE

The headstock base casting weighs about 70,000 pounds, each of the boring bench sections weighs over 43,000 pounds and the bed sections are from 68,000 to 73,000 pounds in weight. Early in the present year 13 of the head-of the boring bench castings had been made and machining proved them to be structurally perfect.

As may be seen in Fig. 2, the bed of the lathe is formed by seven sections, which when bolted together stretch out over 200 feet. Three sections are bolted together to make the complete boring-bench, which carries and guides the boring bar. The lathes have no tailstock, but are provided with a series of steady-rests in which the work is turned as the bar travels forward. The bed, boring-bench, and headstock castings, it will be appreciated, must be cast within close tolerances to allow machining to the precision which is demanded in these tools.

Similarity permits the bed sections to be molded from the same patterns with the proper conjunction pieces. The four sections at the headstock end of the machine are the same. They are 10 feet wide and from 30 to 35 feet long. The remaining three bed-sections are only 6 feet wide and about the same length.

The bed-sections are all molded in pits. A preliminary bed of coke

FIG. 3 BED SECTION AS IT COMES FROM THE SAND—NOTE THE BARS WHICH SUPPORT THE HANGING CORES FROM THE COVER CORES

is laid Upon this heap sand is placed and leveled to the same height as the straight-edges in the bottom of the pit. Sweeps are next employed to form grooves for core prints between the straight edges. A sectional pattern then is moved along, resting upon the straight-edges as shown in Fig. 1 and lined by checks, *AA*, which fit the print grooves. The pattern is moved forward four times and rammed successively until the outer contour of the bed section is formed. The inner webs, and channel sections are formed in dry sand cores, which are made separately in core boxes, provided with stop-offs to give the desired length. These are practically cover cores. As the bed sections are molded with the upper or machined face down, it is imperative that there shall be no chaplet marks in the surface. For this reason it is necessary to suspend the inner cores from the top and hang them on the cover cores. This method of coring is illustrated at *B* in Fig. 4. Straight core arbors are used, and are wired together at right angles to support the hanging portion of the core upon the flat cover portion. The cover cores are outlined by dotted lines in Fig. 4. The bars which support the hanging cores, also may be noted in Fig. 3, which shows one of the bed sections as it came from the sand. A $\frac{3}{4}$-inch dip is provided at the center of the mold to compensate for warping in the bed casting as it cools. The T-slot shown in the center channel of the base in the cross-section presented obstacles to the usual method of coring. This slot, shown at *C* in Fig. 4 is machined on all surfaces and must be sound throughout. Any system of coring to provide this slot would have been subjected to a tremendous crushing force from the weight of metal above, and cooling stresses would have jeopardized the overhanging section. It therefore was decided to cast this portion solid as shown by the dotted line and machine the slot entire.

The great lifting force which one of these sections exercises will be appreciated from the amount of area which is shown in the finished casting. To counteract this force, an ingenious system of weighting is used. This may be understood more readily from Fig. 5. When the cover-cores are placed over the entire mold, a series of railway rails are laid longitudinally so

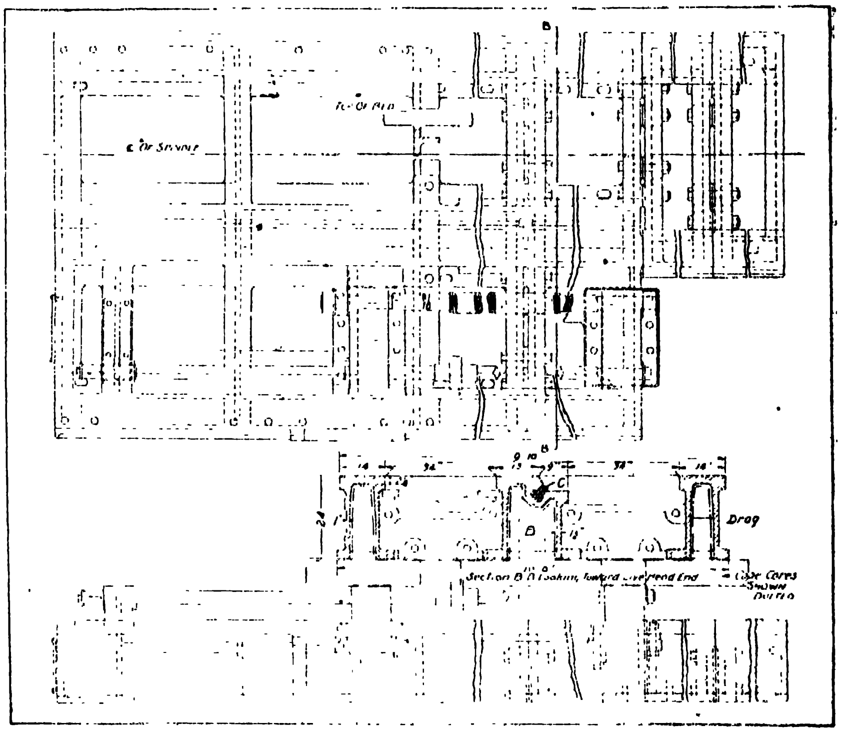
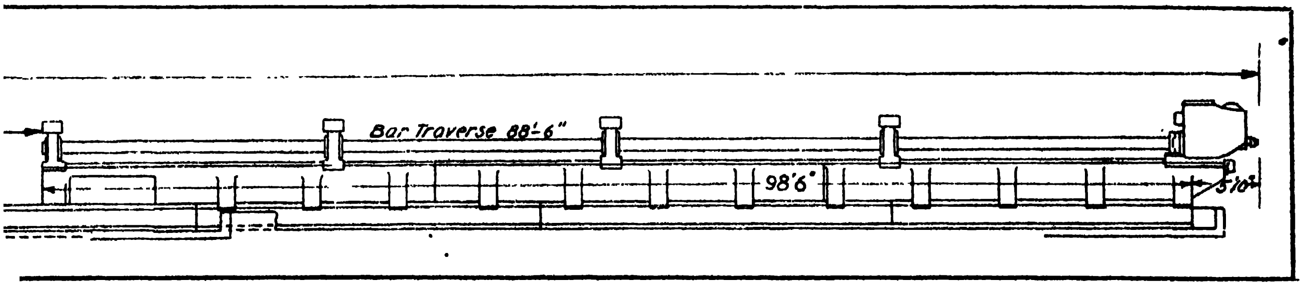


FIG. 4—PLAN AND SECTIONAL VIEW OF BED SECTION—THE SYSTEM OF CORING IS INDICATED BY THE DOTTED LINES IN THE SECTION *B B*



REQUIRED TO FORM THE BED, WHILE THREE SEGMENTS BOLTED END TO END SERVE TO SUPPORT THE BORING BAR WITH ITS 88-FOOT TRAVERSE

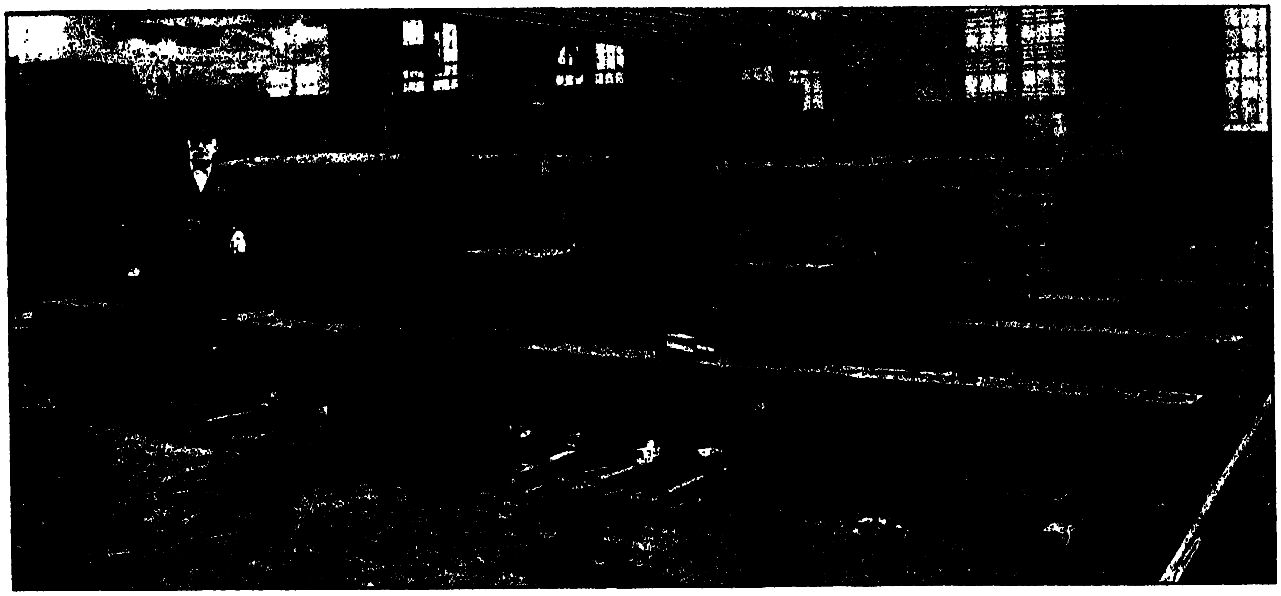


FIG. 5—SYSTEM OF WEIGHTING THE HEAVY PIT MOLDS FOR POURING—THE WEIGHTS ALL ARE SUPPORTED ON LINTELS AT A SAFE DISTANCE FROM THE EDGE OF THE MOLD

that each separate core has a bearing against two or more rails. Then cast-iron lintels are laid alongside the mold, 5 or 6 feet back from the edge. Upon these are placed the transverse weights shown in Fig. 5. These extend across over the mold and upon them is piled a series of weights as shown. This arrangement allows the entire weighting system to be carried upon the lintels along the side, so that there is no danger of crushing in the sides of the mold, nor the cores. The rails resting upon the cover cores are wedged firmly against the weights above, so that any lifting force is transmitted to and resisted by the weights. The cast-iron blocks used weigh from 8 to 12 tons apiece, and are provided with side lugs to which the crane chains may be attached for handling them about the shop.

In pouring the bed-section molds, metal enters the mold from both ends simultaneously. One of the runner-boxes is shown in Fig. 5. A similar box is located at the far end of the mold. Two runners lead to the bottom of the mold at each end and from this point the metal flows along the main channels at the center, around the outer walls and up until the entire mold is filled. Eight risers are used, each 4 x 6 inches. This liberal riser capacity is an additional insurance of sound metal.

Metal is tapped from two of the three cupolas with which the foundry is provided. Three ladles are used in pouring. The metal is started at one end from a 25-ton ladle. Over the center of the mold a second crane holds ready a 10-ton ladle, while at the opposite end a third crane holds and pours a 10-ton ladle from which the second runner cup is served. As the first 10-ton ladle is emptied it is swung away and the reserve ladle over the center is brought in place and tilted to continue the pouring as nearly without interruption as is possible.

Removing the gates and risers from these large bed sections constitutes a problem. It is sometimes found that although liberally nicked around the base the ordinary sledge does not serve to jar them loose. In this event a 2000-pound weight is suspended from one of the overhead cranes and placed against the offending riser. Two men then pull it back as far as possible and allow it to swing and strike the riser. The inertia force usually is sufficient to break the head from the casting.

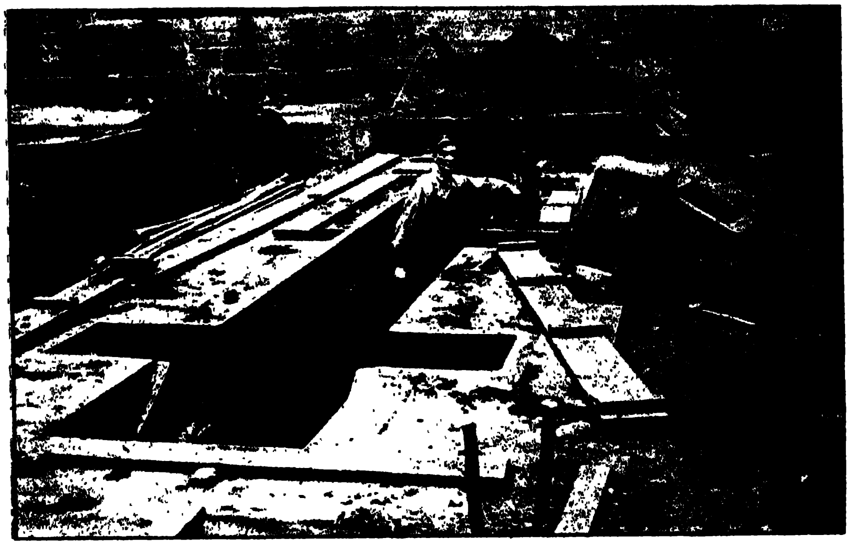


FIG. 6—MOLD FOR BORING-BENCH SECTION WITH ONE PART OF THE COPE REMOVED—DRAWING THE LOOSE PIECES WHICH FORM THE WINGS

The procedure in molding the boring-bench castings is somewhat similar to that employed on the bed-sections. In this case the pit is prepared with the sub-bed of coke and the surface of sand, swept level with the straight-edges in the bottom and a central recess running the entire length of the mold is bedded in to receive the core print. Light sectional patterns with loose pieces shown at the side of the mold in Fig. 6 then are placed and rammed. As may be noted the boring-bench is molded with the sliding surface up, in an inverted position to that which it occupies when assembled in the machine. With the pit portion, or drag half of the mold rammed, two large flasks are placed to form the cope. These are barred, rammed in position, and eight liberal risers are formed, one being placed over each of the "wings," or slide-arms, of the bor-

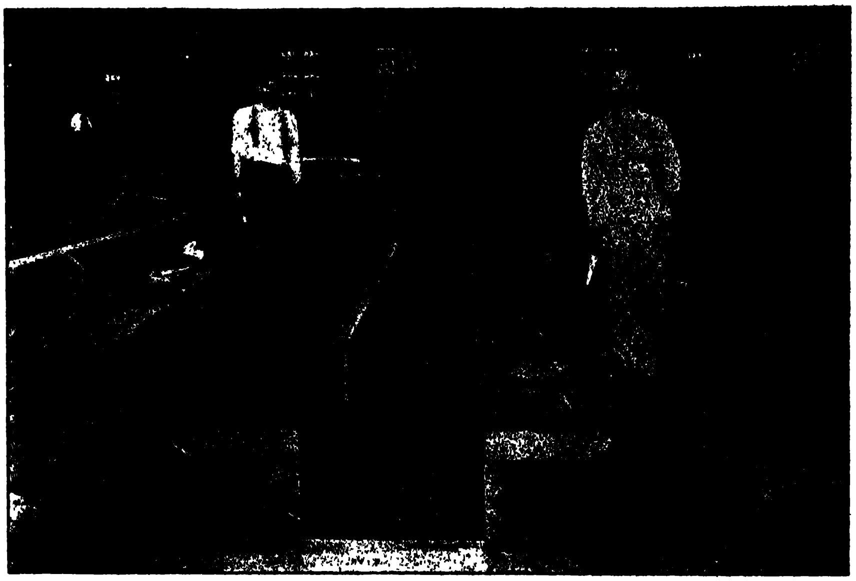


FIG. 7—MOLD FOR BORING BENCH SECTION COMPLETED AND BLACKED READY TO RECEIVE THE CORES

ing bench. The corners of the flasks then are located by stakes; the two cope sections are removed and set upon supports which elevate them above the floor to a height of about 3 feet. Corrugated iron sheets then are placed about the sides and the copes are dried by a charcoal fire.

A number of cores are used to form the central cavity. These cores are supported upon prints in the bottom of the mold box section of the boring-bench casting. The complete assembly of cores is shown in Fig. 8. The cores for the side-arms are supported at one end by the central core and on the under side by core prints which rest on the bottom of the slide-arm recesses. All cores are provided with ample vent openings, filled with coke and protected from inflowing metal by the rings of fireclay and sand shown about each of the core-vent openings in Fig. 8. Two pairs of draw-gates each fed by a common runner are used to pour the boring-bench castings. Each gate is 2 x 2 inches, and a 4 x 4-inch section is provided in each of the risers. Two 11-ton ladles are used to pour simultaneously from opposite ends.

The headstock castings present the most complicated problem in molding. The drawing reproduced as Fig 12, and the two views of the casting shown in Fig. 11 illustrate the intricacy which, when combined with great bulk, make this piece the most difficult to mold. These great blocks, weighing over 70,000 pounds, support and, with a lighter cap-casting, house the turning mechanism for the huge lathe. It was found expedient to mold them with the upper surface down, to aid in coring the lower half of the driving-gear housing, shown at *D*. This feature necessitated a draw-back about the corner in which this portion was molded. This method was developed by the foundry superintendent, Louis Baden, who has been largely responsible for the success of this large lathe work.

The pit first is prepared as in the case of the other castings for the heavy lathes. An additional space is allowed around the corner in which the draw-back is to be formed. Sheeting is set up along the three walls of this portion of the pit, and inside of this and held apart from it by wedges is a second lining of sheeting. A heavy plate with lifting rods is placed in the bottom of the pit, occupying practically the position shown by the dotted lines in Fig. 12. A bed is prepared in the customary manner, and the pattern pieces are set.

A parting is formed dividing that portion of the mold which overhangs the lifting plate from the rest of the mold, but with this exception the mold is rammed in the usual manner. The cope flasks next are set, rammed and removed. The wedges between the two walls of sheeting then are removed, and the plate carrying a portion of the mold surrounding the driving gear housing is drawn back and lifted from the pit. The cores now are placed without difficulty and the portion of the mold which has been lifted out is replaced and sand is rammed solidly back of it.

Another difficulty is encountered in placing the cores in the heavy frame section shown at *E* in Fig. 11. The two outer and center walls are pierced by circular openings which are on the same line, and these openings have hubs or bosses extending from the walls to give additional support and rigidity to the motor drive shaft of the lathe. To accommodate these hubs, it is neces-

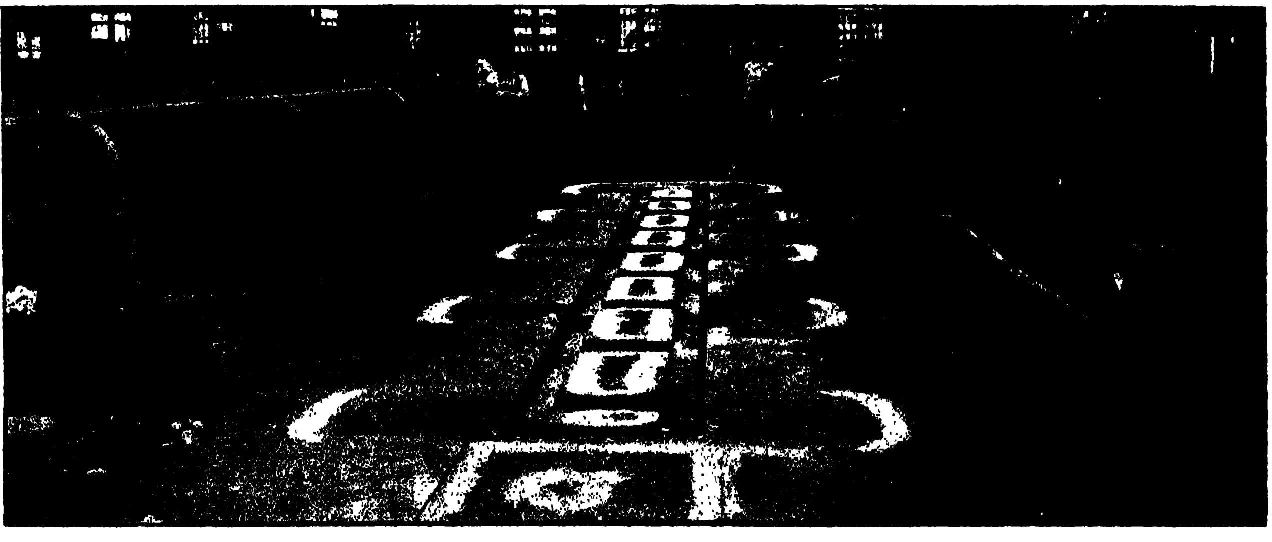


FIG. 8—COMPLETED MOLD WITH CORES IN PLACE READY TO POUR THE BORING-BENCH SECTION—NOTE THE LIBERAL VENTING OF ALL CORES AND METHOD OF SUPPORTING THE WING CORES AGAINST THE CENTER

sary to split the inner cores horizontally. This allows the core forming the circular openings through the three walls to be made in one piece and insures the alignment of the three holes. The lower halves of the inner cores are held up by prints which extend through at the points *F*, and are supported laterally by prints carrying through to the side of the mold. The larger recess shown at *G* with the inner hub are formed from cores.

The percentage of loss in these headstocks has been practically nil. Four risers, 6 x 6 inches in size, are provided in making these castings. The metal is poured into two draw gates located at opposite corners.

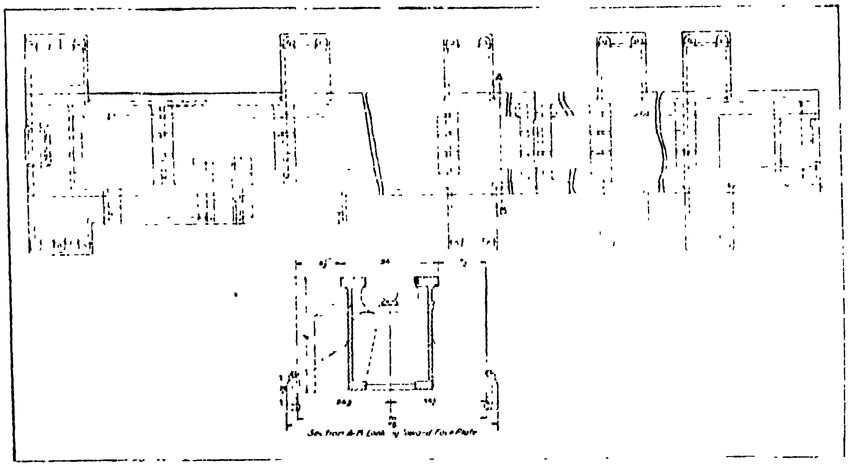


FIG. 9—PLAN AND SECTIONAL VIEWS OF THE BORING BENCH CASTING

The molds for the bed-sections, boring-benches and headstocks are all blacked thoroughly before drying with a preparation of plumbago, talc and core-wash. After blacking, each pit mold is covered with strips of corrugated iron and two or more oil torches, placed at opposite ends, serve to skin-dry the mold in about five hours' time. The torches are moved about from place to place at intervals, either by the workmen on the floor or by the night-watchman, in order that all portions of the mold may be dried evenly.

It will be appreciated that good metal and high pouring temperature are necessary to assure sound castings on this class of work. The average analysis showed about 2 per cent silicon, from 0.50 to 0.55 per cent manganese, 2.49 per cent graphitic carbon, 0.59 per cent combined carbon, 0.82 per cent phosphorus and 0.10 per cent sulphur. Three large cupolas, built by the predecessors of the Whiting Foundry Equipment Co., Harvey, Ill, provide ample capacity for this heavy work and in addition for a variety of medium and light castings needed in the company's tool building shops. The cupolas are lined to 48, 60 and 68 inches, respectively. During the war, with the stress of hurried production, this foundry melted about 75 tons per day. The production since has averaged 60 to 65 tons per day on all classes of work.

Great efficiency governs the handling of materials to the cupolas, as well as carrying the metal to the pouring floors. The storage yard which adjoins the foundry building is served by two 10-ton Niles cranes. One of these commands the scrap, iron and coke piles. The other reaches over the sand storage. A 25-ton crane extends over the yard where many of the finished castings await transportation to the machine shop. An ingenious feature has been provided to obviate the use of timbers, which usually are employed to prevent castings from resting on the ground. Concrete walls have been built which are elevated about 6 inches above the ground. These are about 12 inches wide and the edges are formed by the corners of angle bars which are tied together at intervals by bolts embedded in the concrete. The walls provide a permanent foundation upon which to pile the castings until needed, and are protected from chipping and abrasion by the angle-bar edges.

The cupola materials are handled by the crane from the storage yard to an elevated platform at the same height as the charging floor, but outside the building. Trays holding from 8000 to 10,000 pounds are used to convey the scrap and pig iron to the outer platform, where they are lowered upon light trucks and wheeled to the charging floor. Here the mixtures are made in light charging cars which run from floor scales to the cupola doors. Cans, holding about 125 pounds each, are filled with coke at the yard pile. Sixteen of these are placed upon a platform which is picked up by the yard crane and swung to the elevated platform where it is placed on a truck and wheeled in to the charging floor.

Care is taken to have a great quantity of sand in storage at all times in this plant. Ten roofed yard bins of 160 tons capacity each, provide facilities for reserve and allow the company to ship and fill its requirements before

FIG. 10—BORING-BENCH CASTING AS IT COMES FROM THE SAND—THE SYSTEM OF DRAW GATES AND THE LIBERAL RISERS PROVIDED MAY BE NOTED

FIG. 11—TWO VIEWS OF THE LARGE HEADSTOCK CASTING—THE LOWER HALF OF THE MAIN DRIVING GEAR HOUSING, SHOWN AT THE END NECESSITATED THE DRAW-BACK

November of each year. Thus no sand is shipped in during bad weather, and that which is at hand has an opportunity to dry and condition before it is needed. A 700-ton bin inside the foundry supplies the daily needs and is kept filled from the outside sheds. From this bin the sand is wheeled and shoveled into a disintegrator which breaks the lumps. It drops from this machine upon an elevating conveyor which carries it to a revolving riddle type Standard mixer through which it travels and drops into a hopper. This hopper empties upon an elevating conveyor which carries the sand up and drops it into overhead storage bins. Drop shutters in these bins allow the sand to run into steel boxes in which it is conveyed to the various parts of the foundry as needed, or upon heaps beneath the bins adjacent to the light molding floor.

Jeffry storage-battery trucks with trailers are used to carry the sand from the side bay to the main floor where it is picked up by cranes and placed where needed. The trucks also are used to move ladles of metal from the cupolas to the side floor bay.

It will be realized that this plant must be unusually well equipped with cranes. The central floor where the heavy work is handled is served by three 30-ton overhead, girder type cranes, and three 6-ton traveling jib cranes supported and traveling along the line of columns separating this floor from the two side bays. Two of the three 30-ton cranes are required to pull the large lathe sections from the sand and to convey them to the cleaning floor.

Over the side bay in which the castings up to 20,000 pounds or "medium" work is handled, are four 10-ton Niles overhead girder-type cranes and six 5-ton traveling jibs. The latter are in constant service, moving flasks, boards, and sand and rolling-over or closing molds. The overhead cranes are used for all pouring work on this floor.

The Niles foundry is remarkable for its exceptional fire prevention features. All floors in all departments have complete sprinkler systems. It would seem that this would be unnecessary precaution in the main foundry building with its steel-frame, brick-wall construction, where no wood flasks and little other material of inflammable nature is used. However, the wisdom of the measure was proved while one of the large lathe castings was being poured.

Two ladles were in action, each controlled by hand wheels on the ladle frame. Through some error one craneman allowed the bottom of a ladle to rest upon some object on the floor, with the result that it swung suddenly around and tore the control wheel from the grasp of the man who was pouring. This allowed the metal to splash as the ladle swung from side to side, and immediately a column of flame drove the craneman above from his cage. However, a sprinkler head was touched off, and the descending column of water protected the men and allowed them to approach and reach the ladle wheel. Another workman climbed to the crane cage, and while others stood and threw water over the workman handling the ladle, he stood on boards hurriedly thrown upon the metal upon the floor and completed the pouring. The casting was saved.

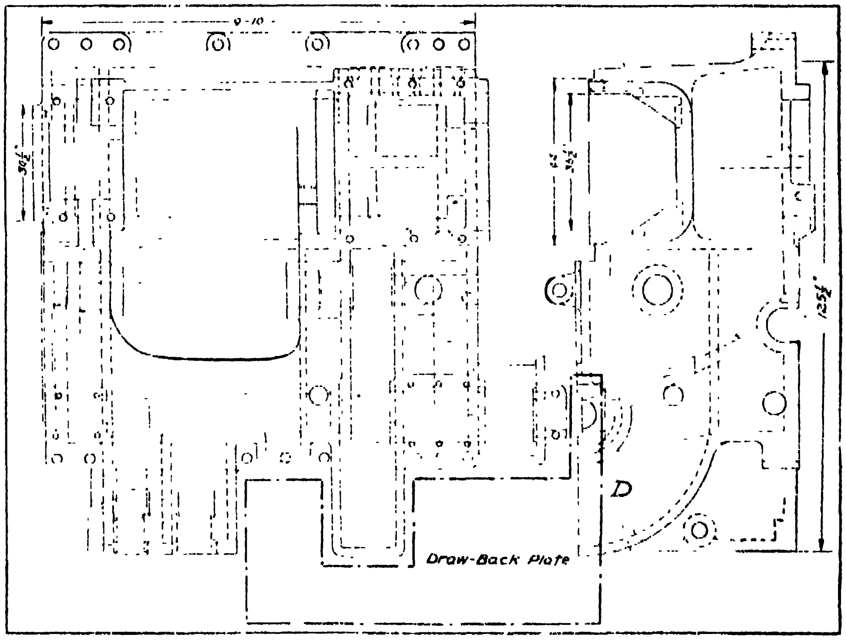


FIG. 12 PLAN AND SECTIONAL VIEWS OF THE HEADSTOCK CASTING WITH THE AREA INCLUDED IN THE DRAW-BACK INDICATED

In the four-story pattern storage building adjacent to the main foundry building are stored thousands of patterns for the great variety of machines which this company has built. Here, too, the sprinkler system confined an incipient fire to one shelf section not over 20 feet square, where the entire building was jeopardized.

The Lincolnville Mfg. Co., Lincolnville, Kans., are preparing to build a foundry to manufacture castings for an air-craft motors as well as other gray-iron castings.

Suggested Improvements on Converter Wind Box

Changes in the construction of the wind box on side blow bessemer converters as shown in the accompanying illustrations have been made the subject of a patent by Albert Rommelaere, South Vancouver, British Columbia, Canada.

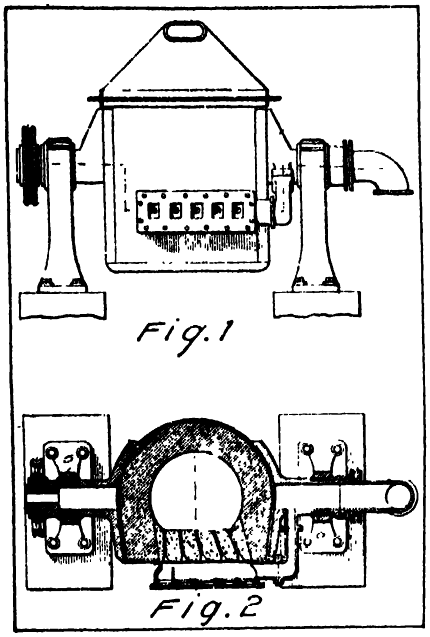


FIG 1- SIDE ELEVATION OF THE DEVICE FIG. 2 SECTION OF FIG. 1 ON CENTER LINE OF TRUNIONS SHOWING ANGULAR POSITION OF THE TUYERES

The objects of the invention, as claimed by the inventor are: (1) To provide a converter of this type with a wind box having a knockout back. This is accomplished by cutting away the shell of the vessel the full area of the inside of the wind box, thus providing a space whereby the refractory lining may easily be removed or replaced. (2) To provide a wind box having a number of tuyeres leading therefrom, these tuyeres being arranged at different angles with respect to one another so as to produce a rotary movement of the contents of the converter, by means of which different portions of the molten bath are brought successively under the oxidizing action of the air blast, thus providing a uniform distribution of the air and preventing over oxidation of molten contents at any one portion. (3) To provide a wind box with openings or peep holes so arranged that the contents of the converter may be viewed through the tuyeres without necessitating the suspension of the blowing operation or the tilting of the converter and the removal of the cover. (4) To provide for the removal of obstructions in the tuyeres. This is accomplished by means of doors in the wind box cover through which a rod may be thrust to clear the obstruction. The doors open inwardly and therefore the internal pressure normally tends to keep them closed tightly thus preventing leakage.

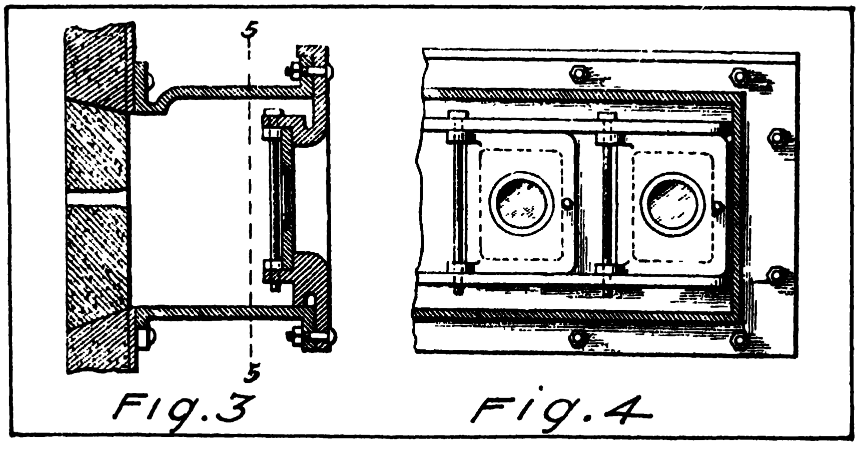


FIG. 3- SECTION AND DETAIL OF WIND BOX FIG. 4—DETAILS OF DOORS SHOWING THE ARRANGEMENT OF PEEP HOLES

Organize New Export Corporation

For the group development of the foundry equipment export trade under the provisions of the Webb act, the Foundry Equipment Export Corp. has been organized to engage in the sale of all kinds of foundry supplies, equipment and accessories required by casting manufacturers. The corporation has been incorporated under the laws of Delaware with a capital of $50,000. A temporary office has been established at room 114, 40 Wall street, New York. The following companies are stockholders of this export corporation:

American Foundry Equipment Co., New York, sand cutting machines and sand blast equipment.

Grimes Molding Machine Co., Detroit, molding machines.

Arcade Mfg. Co., Freeport, Ill., molding machines.

American Molding Machine Co., Terre Haute, Ind., molding machines.

S. Obermayer Co., Chicago, foundry equipment and accessories.

Buch Foundry Equipment Co., York, Pa., molding machines and foundry accessories.

National Engineering Co., Chicago, sand grinding equipment, grinding pans, etc.

E. J. Woodison Co., Detroit, molding machines and foundry supplies.

Whiting Foundry Equipment Co., Harvey, Ill., sand blast equipment, cleaning room machinery, furnaces, cupolas, etc.

J. W. Paxson Co., Philadelphia, sand blast machines and other foundry equipment.

Officers of the Foundry Equipment Export Corp. follow: Col. T. S. Hammond, Whiting Foundry Equipment Co., president; L. L. Munn, Arcade Mfg. Co., first vice president; E. J. Woodison, E. J. Woodison Co., second vice president; V. E. Minich, American Foundry Equipment Co., treasurer, and S. T. Johnston, S. Obermayer Co., secretary. The executive committee consists of R. S. Buch, Buch Foundry Equipment Co., V. E. Minich, G. L. Grimes, Grimes Molding Machine Co., S. T. Johnston and the president. Alba B. Johnson Jr., Morris building, Philadelphia, has been engaged as manager of the corporation. After completing an initial survey of the products manufactured by the stockholders, he will go to Europe where headquarters probably will be established in London and from which European operations will be conducted.

Collapsible Core Prevents Cracking Castings

By H. E. Diller

Question- We are making a number of cast-iron rings which must be chilled on the inside. In making these rings we have used an iron core. This chills the iron satisfactorily but the rings all break owing to shrinkage. Please tell us how to get the chill without cracking the casting.

Answer—We would recommend that you use collapsible iron core with arrangements for withdrawing the core as soon as the metal in the casting is set. A few trials along this line will soon establish the length of time which should elapse before removing the core.

Copper Diffuses Through Cast Iron

Annealing Experiments With Copper Oxide Packing Show That Copper Penetrates Into Malleable Iron—Gray Iron Affected Differently—Graphite Changed So That It Appears Like Temper Carbon

BY H. E. DILLER

IN experimenting to ascertain the effect of different oxidizing packings on annealing malleable iron a bar was packed in copper-oxide packing and annealed at 1000 degrees Cent. When the bar was taken from the furnace it was found that the copper oxide had been reduced to metallic copper and melted and that it had penetrated into the iron. An average sample of the bar showed that the carbon had been reduced from 2.70 to 0.60 per cent and there was 21.4 per cent copper.

A micrograph of this bar showing black blotches of copper all through it is seen in Fig. 1. A test showed a strength of 68,200 pounds per square inch and an elongation of 1 per cent in 2 inches. It was thought that the high percentage of copper would materially increase the conductivity of the metal but this was proved to be not so by a test which showed the resistivity was 17, which is approximately 10 times that of annealed copper.

Some time after this first experiment other tests were made of a similar nature. In the second trial, however, the test pieces were packed in 3-inch pipes with black copper oxide and the pipes were placed on top of the pots in a regular annealing furnace. The pyrometer in the furnace did not register above 925 degrees Cent. but the copper oxide was reduced and the copper fused together, although it had not been completely melted.

In the second experiment the bars were heated approximately 100 degrees Cent. lower than the temperature reached in the first experiment and the results were somewhat different. When the bars were cut cross-wise at different places no copper was noticeable except in the center near the middle of the bar, and close to the edge all over the bar.

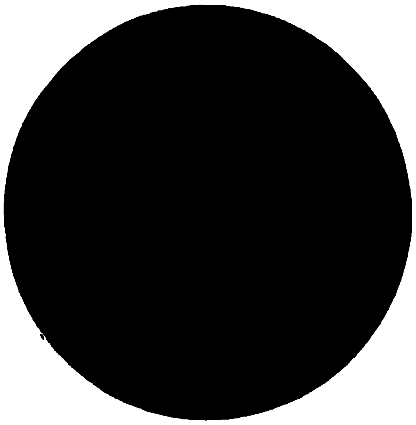


FIG. 1—MALLEABLE IRON CONTAINING MORE THAN 20 PER CENT COPPER

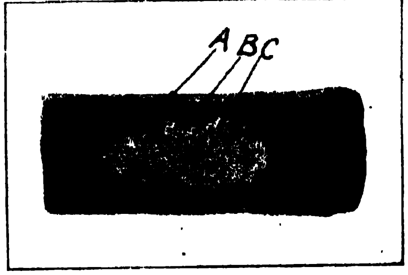


FIG. 2—CROSS SECTION OF MALLEABLE BAR ANNEALED IN COPPER-OXIDE PACKING

Fig. 2 shows the cross-section at the middle of a bar. Fig. 3 is a micrograph taken at the outside edge of the cross-section. The dark portion in the upper part is copper. The white at the bottom is ferrite and the dark places toward the center are pearlite. The band of lighter material is a heterogeneous mixture of cementite, pearlite and ferrite. The structure here is more like a complicated high-carbon steel than like malleable iron.

The dividing line between the areas *A* and *B*, Fig. 2, is shown in Fig. 4. The white portion is copper and the dark particles are iron. It can be seen from this micrograph how thoroughly the iron and copper are knitted together. Some iron particles were distributed through the copper just as some of the copper penetrated into the casting.

The structure of section *B*, Fig. 2, is similar to that usually found in malleable iron. No particles of copper were found in it. In the area *C* just inside of the section *B* there are a large number of small copper areas in a matrix of high carbon steel. In this area occasional patches of white ferrite are found. One of these patches of ferrite is shown in Fig. 5 which also shows the copper scattered through the dark matrix. As the copper color does not show in the illustrations as it did to the eye under the microscope, so the micro-

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Abstract of a paper presented at the Philadelphia meeting of the American Foundrymen's association, Sept. 29-Oct. 3. The author, H. E. Diller, is associate editor of THE FOUNDRY.

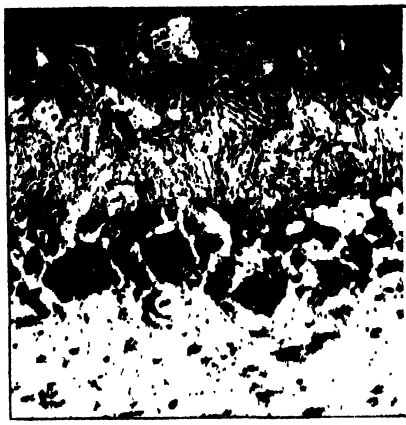


FIG. 3—OUTSIDE EDGE OF BAR SHOWN IN FIG. 2

FIG. 4—DIVIDING LINE BETWEEN *A* AND *B*, FIG. 2

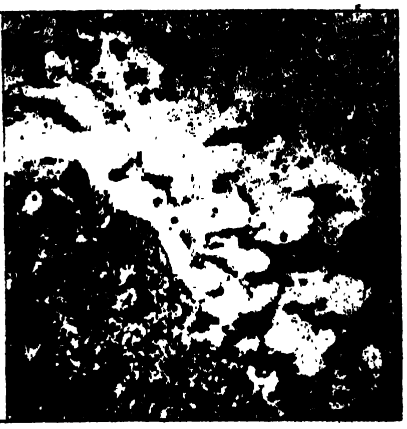


FIG. 5—CENTER OF BAR SHOWN IN FIG. 2

graphs do not bring out the copper as clearly as a direct view of the sample would do.

The effect of copper oxide packing on the malleable iron bars created a desire to find out what influence it would have on gray-iron annealed in it. Therefore gray-iron bars the same size as the malleable bars which were treated were packed and annealed in the same way as the malleable bars.

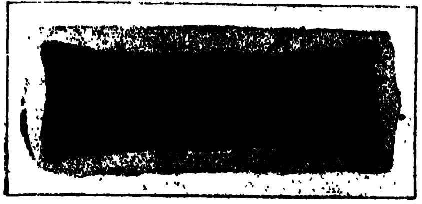


FIG. 6—CROSS SECTION OF GRAY-IRON BAR ANNEALED IN COPPER-OXIDE PACKING

The results were quite different in the case of gray iron than in the case of malleable iron. This is illustrated in Fig. 6 which shows a cross-section of one of the bars. Three distinct areas can be seen. The area *A* contains all of the copper. There is a thin layer of copper on the outside and next to this the copper is very finely divided and is in the form of drop-like areas surrounded by a matrix of iron. This matrix has a peculiar structure and is more like steel than it is like gray iron. The line between *A* and *B*, Fig. 6, is shown in Fig. 7. The dark area is the portion containing the copper. The light portion in the same figure represents the structure of the section marked *B* in Fig. 6. The same structure is seen in the upper section of Fig. 8, which is part of the dividing line between areas *B* and *C*. This structure is almost like the structure of malleable iron in its appearance under the microscope, but scattered through it can occasionally be seen flakes of graphite.

The center of the bar *C*, Fig. 6, has the structure of unchanged gray iron. This is shown in the lower section of Fig. 8.

W. E. Ruder of the research laboratory of the General Electric Co., Schenectady, N. Y., who made the micrographs for this paper, said in regard to the changed structure of the gray-iron bar: "The only explanation which I can give for the peculiar structure shown is that the entire material up to the dividing line between *A* and *B*, Fig. 6, was in a semimolten condition, and while in this condition the copper oxide became mixed with it and the oxygen was given up by the copper and united with the graphite. The changing of graphitized carbon to temper carbon in section *B* is very unusual and until this experiment I did not think that this change could be brought about short of actual fusion."

Chain Belt Co. to Build New Plant

Plans of the Chain Belt Co., Milwaukee, whose stockholders recently voted to increase the capital stock from $1,000,000 to $2,800,000, contemplate the ultimate evacuation of the plant at Sixteenth and Park streets, and its removal to a 23-acre site at Thirty-ninth and Orchard streets. Building operations are to progress by departmental units as rapidly as business conditions, removal difficulties and other considerations will permit.

The first unit to be erected will be a brick and steel structure, 150 x 316 feet, to house the concrete mixer assembling department. The plans and work for this as well as for the entire project are under the supervision of Frank D. Chase, Inc, Chicago. The new assembling plant will be among the best lighted and ventilated factory buildings in the city.

FIG. 7—DIVIDING LINE BETWEEN *A* AND *B*, FIG. 6

C. W. Levalley, the founder of the company, served as president until 1916 when he retired to become chairman of the board. He died in 1918 at the age of 84 and was succeeded as president by William C. Frye. Mr Frye joined the company at the age of 17 and is the oldest employe in continuous service. He is actively interested in a number of other companies and holds executive positions in a number of allied interests. He is secretary and treasurer of the Sivyer Steel Casting Co., vice president of the Federal Malleable Co., and a director of the Electric Steel Casting Co., Chicago.

C. R. Messinger, vice president and general manager of the Chain Belt Co., is also vice president and general manager of the Sivyer Steel Casting Co., secretary of the Federal Malleable Co., and a director of the Electric Steel Co.

Other officers of the Chain Belt Co. are W. C. Sargent, secretary, who was elected in 1900, and is also treasurer at the Federal Malleable Co., and C. L. Pfeifer who has served as treasurer of Chain Belt Co. since 1916, having previously occupied a position as comptroller. Donald Fraser, for many years vice president of the company, is now consulting engineer. He is also second vice president of the Sivyer Steel Casting Co. and Federal Malleable Co.

Suitable Cylinder Iron

By H. E. Diller

Question:—I have taken a position with a foundry making automobile cylinders and would like to know what composition of iron is being used in cylinders by the leading automobile manufacturers.

Answer:—There is a considerable range in the composition of cylinder iron made by different foundries. Most of them make iron which will fall within the following limits: Silicon, 1.75 to 2.75 per cent; phosphorus, 0.150 to 0.300 per cent; manganese, 0.40 to 0.90 per cent and sulphur under 0.10 per cent.

The analysis is not the only thing to be watched in iron for cylinders. Some firms use 10 to 20 per cent charcoal pig iron in their mixtures, while other firms use all coke pig iron. It is also important that the cupola be properly slagged, and to do this 50 pounds of limestone and 2 pounds of fluorspar should be used per ton of iron melted.

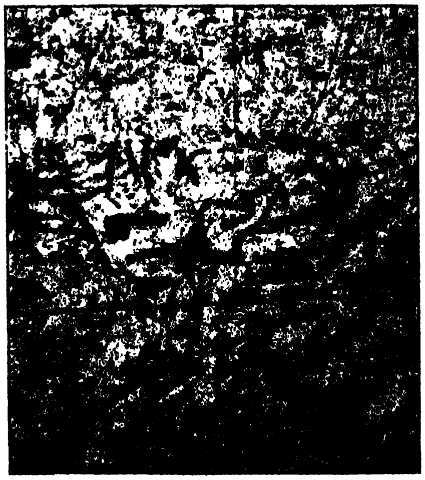
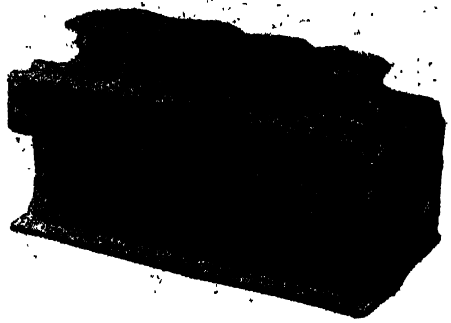
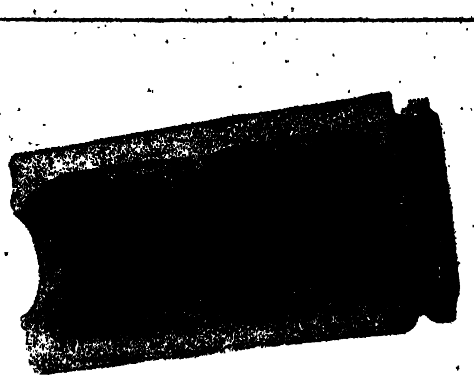


FIG. 8—STRUCTURE OF *B* AND *C*, FIG. 6

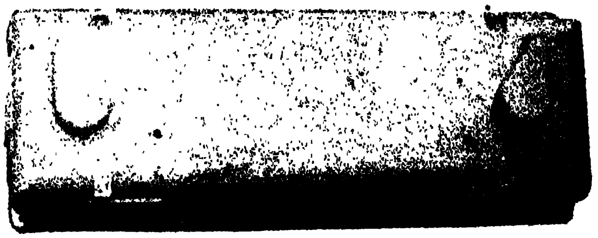
Under differing conditions the amount of fluorspar may have to be varied. You can find out the proper amount to use by watching the cupola, and if an undue amount of slag remains around the tuyeres when the bottom is dropped, or the iron loses an excessive amount of silicon cut down the fluor spar.

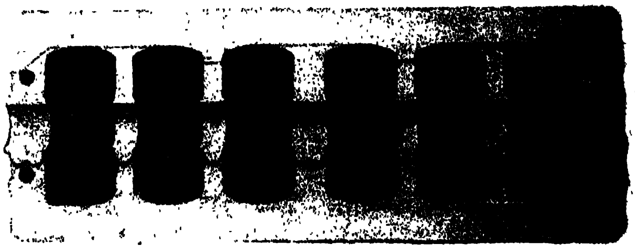
Aluminum Crankcases Made in England

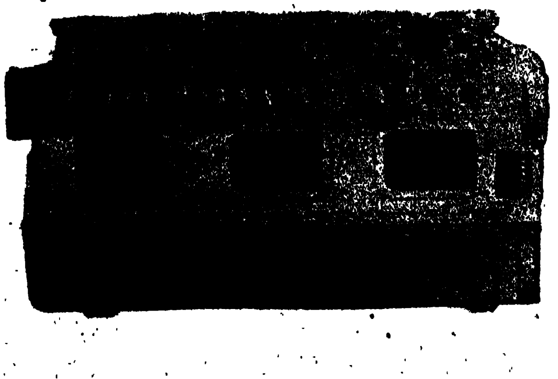


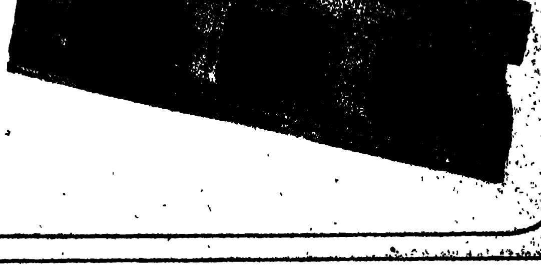


THE various types of aluminum crankcase castings shown in the illustrations on this and succeeding pages were made at the plant of Rowland Hill & Co., Coventry, England They may be said to typify in a certain way the result of the insistent demand for war time production. The automobile industry was the first factor to promote the use of aluminum in machine and engine design, but the war accelerated its use to an unprecedented degree. Motor trucks, lorries, cars of all descriptions, sea planes, airplanes, oilburning engines on submarines and destroyers, all did their bit in creating new uses for and promoting demands for equipment made from the lightest of metals. In common with the engineers of other countries the best brains in the engineering profession in Great Britain were devoted to the problem of designing improved methods and equipment for motor propelled vehicles. They felt that they

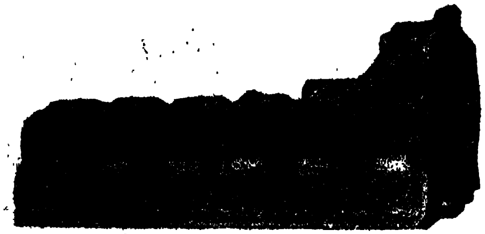


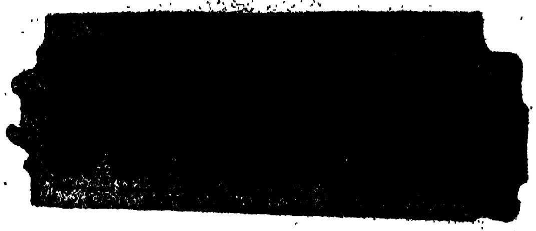


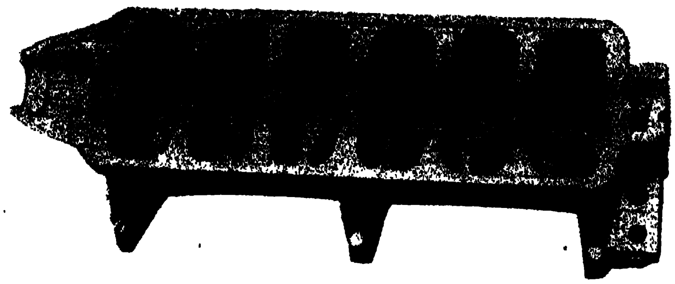




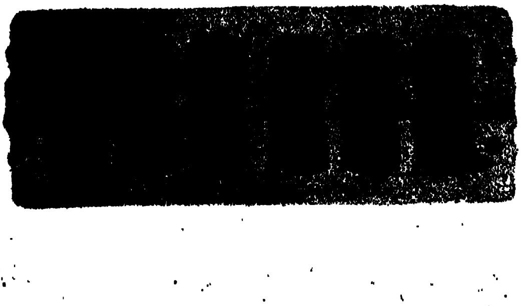
Quantity Production on Aluminum Crank-

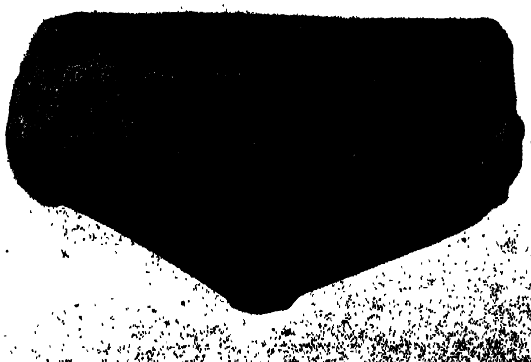




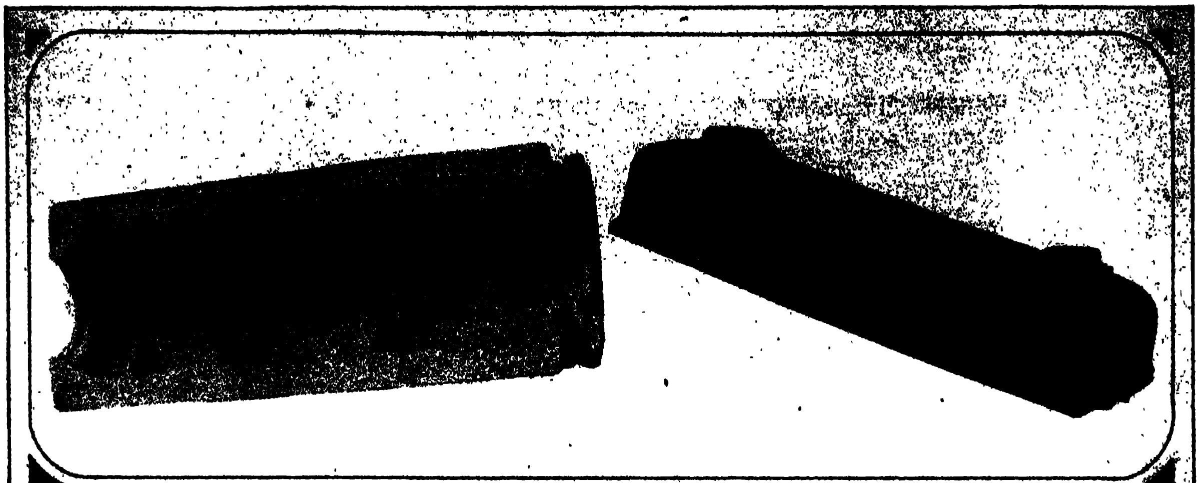


not only had to uphold and maintain Britannia's ancient glory as mistress of the seven seas, but they saw no reason why they should not make a bid as well for supremacy on the land and in the air. The measure of success which they achieved in this laudable ambition during the past four or five years shows that they have reason to be proud of their efforts. The impression seems to prevail on this side of the Atlantic that British designers of engines and machinery in general, confine all their efforts to the features of strength, ruggedness and simplicity. While it is true, in the main that staunchness is a leading characteristic of both the British people and their products, still a glance at the accompanying illustrations should be enough to convince any person that for beauty of design and mechanical perfection these castings compare favorably with those made by any of their competitors in any part of the world.



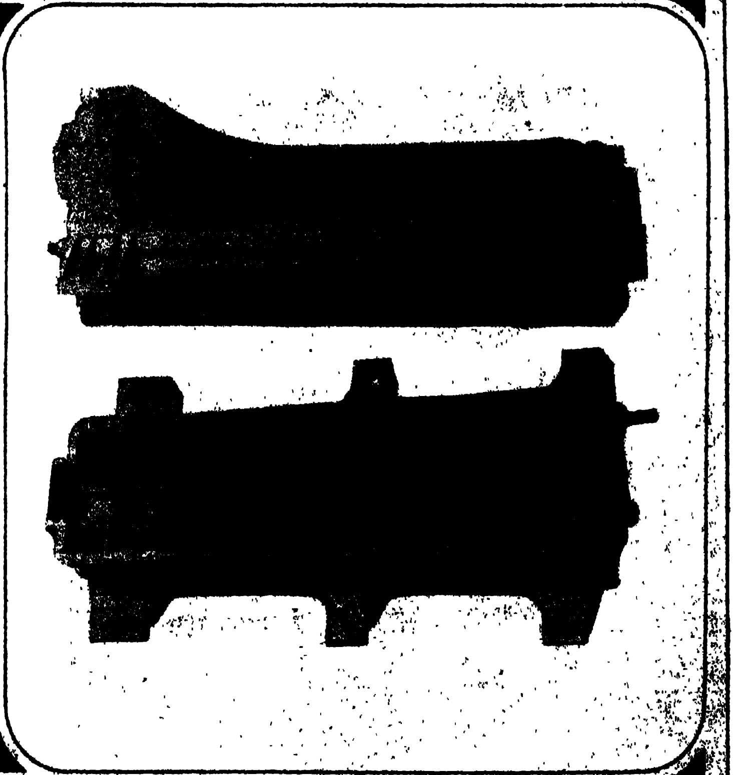


cases Secured by Standard Equipment



Examples are shown of four, six and twelve-cylinder crankcases. The lower halves in each instance have been made in green sand; while the upper halves have been made half green and half dry. The patterns for the upper halves of the four and six-cylinder crankcases were split longitudinally and the casting poured on its side, one large dry-sand core forming the complete interior. The 12-cylinder crankcase was molded with the convex side up. The interior was formed with a series of separate cores which however fitted closely together when in place. Each end of the pattern consisted of a core print the full size of the end. When the pattern was drawn a core having all the necessary bearings, bosses and recesses was dropped into each of these prints.

The machining strips on the ends of the lower half of the crankcase pattern were loose. They were drawn in separately after the main pattern had been removed from the sand.



How and Why in Brass Founding

By Charles Vickers

Fluxes to Cut Slag

We would like to learn of a flux that can be used in open-flame furnaces to cut the slag and metal off the lining. We have used lime, also glass bottles with fair results.

There are a number of fluxes on the market that are good for the purpose mentioned and samples can be obtained from the advertisers in THE FOUNDRY upon request. It would probably be easier to purchase a flux already made than to make one up. If it is preferred to make the flux, the following mixture is good for the purpose. Fluorspar, 1 part; fine hard coal, 1 part; lime, 3 parts If not sufficiently liquid, the lime can be decreased.

Melting Brass Turnings

We would like to know what is the best method to follow in melting brass turnings.

The best way to melt brass turnings is to first melt a small amount of ingot metal. Get the molten metal hot, then dissolve all the turnings possible, using charcoal as a cover for the metal. As fast as the turnings melt and get hot, more should be filled in, until the pot is filled with metal, at which stage a pound or two of phosphor bronze scrap should be added as a deoxidizer. If the turnings are from phosphor bronze, this last addition is not required.

The Casting of Copper

We require a number of copper castings of a special nature in that they must be very much more dense than ordinary cast copper which usually is very porous and of open texture. The castings we require must be of the same closed grain as copper that has been rolled. Can you inform us of any article or book treating of this subject, especially the casting of copper under pressure?

We would like to learn of makers of suitable machinery for producing large copper castings of the nature we have outlined.

We doubt the possibility of so treating copper that it will make castings of the same texture as rolled sheet as it is the working of the copper in rolling that breaks up the crystals and closes the grain of the metal. Putting pressure on the molten metal might cause it to fill out the mold better, but would not affect the grain size. The nearest approach to the effect desired is obtainable by chilling the metal, as this acts to prevent large crystal growth. Copper is densified by chilling and this could be accomplished in the case of these castings by casting them in a graphite mold. The copper will cast in this material, but it would be necessary to introduce the molten copper into the mold by means of a large number of gates, so located that the metal would not have to run far in the mold, otherwise it would chill and fail to run the casting. The core, if the casting uses a core, should be also made of a heat conducting material.

This is perfectly feasible, but the matter would require careful study to make the mold to part properly, to distribute the gates so as to run the casting, to feed the shrinkage of the casting and avoid cracking. The only machinery used in making copper castings, is the rotating metal mold used in making shell bands by the centrifugal method.

Facing Sand for Bronze

We would like to procure a formula for a good facing sand for molding bronze gears weighing about 100 pounds. The castings are made in green sand.

It is not necessary to use a special facing for a bronze casting of 100 pounds weight unless the sand ordinarily used is fine in character. When the sand is too fine the use of a facing will obviate difficulties from scabbing, and blowing. The facing should be free venting so the metal will lie against it without any simmering, and thus produce a sound, clean casting. The following facing mixture can be relied upon to fulfill these requirements: New molding sand, 10 parts; fine silica sand, 5 parts; ground clay, 1 part. Mix these together thoroughly. If a mill is used the facing will be tougher. In the absence of a mill, throw the facing upon the floor and tread it well to mix it. The clay should be fire clay without any grit; a fat clay is best. Ordinary clay may be used, but the best grade is china clay. Silica sand is better than lake, or sea sand and should be used. In its absence use a sharp sand.

Gear Blank Mixtures

We would like to h[illegible] a couple of formulas suitable for making gear blanks, the teeth being cut by machine.

The following alloy makes a good gear bronze as it develops no hard spots: Copper, 88 per cent; tin, 11 per cent; 15 per cent phosphor copper, 0.5 per cent; zinc, 0.5 per cent. The average brinell number of the above alloy is 79, the range being 76 to 80. Another good mixture consists of copper, 86 pounds; tin, 10 pounds; nickel, 3 pounds, and phosphor tin, 1 pound.

What is Duralumin?

We would like some information regarding the metal known as "duralumin." We would like to know just what it is composed of and how it is handled in making castings.

"Duralumin" is an alloy of aluminum, copper, manganese and magnesium. It is not supposed to be a casting alloy, being used almost entirely for rolling and drawing purposes. It can be made as follows: Aluminum, 95.50 per cent; copper 2 per cent; 30 per cent manganese copper, 2 per cent, magnesium, 0.5 per cent.

Melt 2 pounds of copper and 2 pounds manganese copper, and add 4 pounds of aluminum, then ingot. Use this as a hardener by melting 91.50 per cent of pure aluminum ingot with 8 per cent hardener, and when liquid add 0.5 per cent of magnesium. The metal will make sand castings, but it will not be as good for this purpose as an alloy of aluminum 92 per cent, copper 8 per cent.

Holes in Phosphor Bronze

We would like information in regard to the best method of producing phosphor bronze castings without pin holes.

Pin holes in phosphor bronze castings are caused by the metal absorbing gases while it is being melted, and possibly the sulphur from the fuel plays an active part in producing this condition. The metal should be protected while in the furnace and a flux of bone ash, or acid phosphate, white sand and charcoal is useful as a cover. If melted with care no trouble will be experienced from pin holes in phosphor bronze.

Castings for Ship Construction—XIII

Constructing a Double Shaft Bracket Presents Many Difficulties in Patternmaking—This Type Differs Essentially From Others Except in the Barrel Patterns

BY BEN SHAW AND JAMES EDGAR

THREE types of shaft brackets have been considered in previous articles of this series. Yet another type commonly used differs both from the patternmaker's and molder's point of view from those considered. In this bracket the box center rests on a platform of a stern frame. It may be observed that there are two castings joined on the center of the middle box but frequently both the port and starboard brackets comprise one casting even in this type. The single casting has the usual advantage of greater stability or rigidity but it also has disadvantages. If an accident occurs to one bracket, and it is not often that both sides are injured at one time, it is much cheaper to replace a single bracket than a double one. Apart from the cost of the casting there is additional labor involved in removing and replacing plating, etc. However, whether the brackets are designed as one casting or as two the patternmaker's work is not essentially different except that the single pattern being larger is more difficult to handle after it is made. No coreboxes are necessary for this job as it is easier to make the cores in place, the boss core being made as usual with a board. The two table cores as will be seen in Figs. 1 and 2 are separated by a rib, but they are not detached from the arm by a wall of metal extending to the first rib of the arm. Sometimes there is a wall of metal between. In this bracket the included angle is constant from back to front of the tables but this is not always the case. When the angle at the back differs from the angle at the front the work is complicated, for if there is a dividing wall of metal between the table and the arm the patternmaker has to deal with what is called a twisted face. This causes more labor in making the flanges *A* and *B*, Fig. 1. Details for brackets such as are usually supplied by the drafting room are given underneath the working drawings, and it is usually necessary to refer to the drawing of the stem post to get details of frames and plating. With these particulars and the templates from the molding loft, the patternmaker can start work. Templates like Figs 4, 5 and 6 usually are supplied with any additional to those on the drawing noted on the templates.

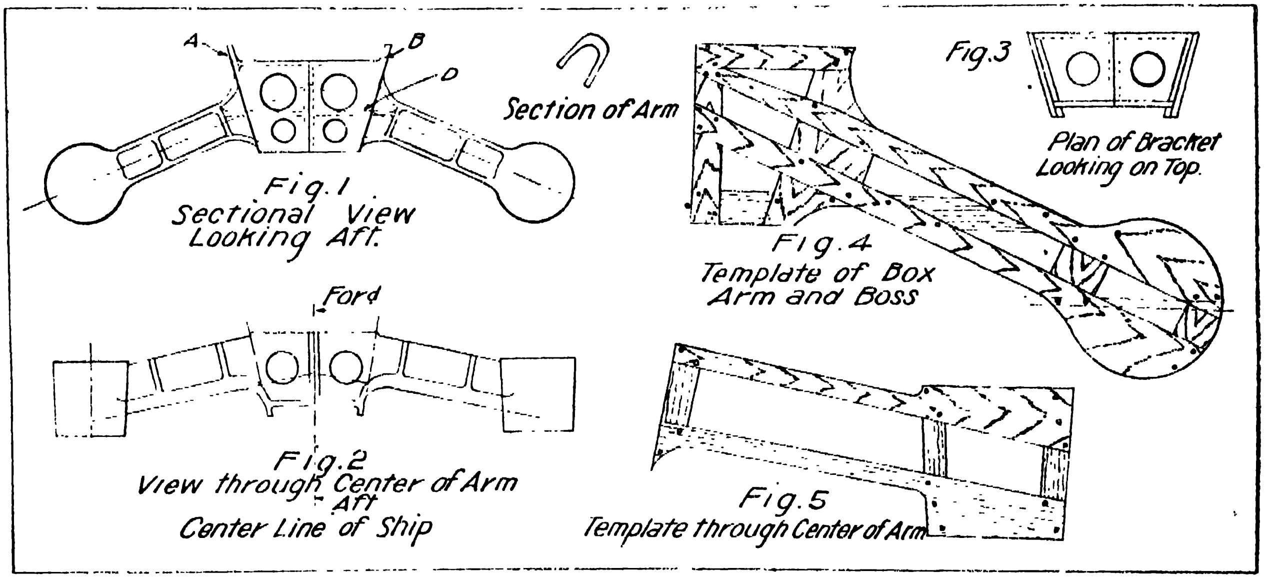

A
B
D
Fig. 1
Sectional View Looking Aft
Section of Arm
Fig. 3
Plan of Bracket Looking on Top
Fig. 4
Template of Box Arm and Boss
Ford
Fig. 2
View through Center of Arm Aft
Center Line of Ship
Fig. 5
Template through Center of Arm

FIG. 1—SECTIONAL VIEW OF DOUBLE SHAFT BRACKET. FIG. 2 VIEW THROUGH CENTER OF ARMS OF DOUBLE SHAFT BRACKET FIG. 3—PLAN OF BRACKET FIG. 4- TEMPLATE FOR BOX, ARM AND BOSS FIG. 5 -TEMPLATE FOR CENTER OF THE ARM

Barrel is Similar

In the previous articles on brackets barrels have been so fully discussed that it is not necessary to say much here except to urge care in building. Before the lagging is fastened on, the framework should be set to center lines and plumb used. The usual arrangements should be made in the barrel for guiding the drawbolts. After the pattern is finished it is wise to screw a thick hardwood bar across the underside of the barrel on which the iron tapped plate can be screwed. This is especially valuable if the barrel is long because the strain of drawing it out of the sand is great, and unsupported the rings or lugs may break.

The three different methods of making large plates may be used to advantage in this work and the relative merits and advantages of each are readily understood. When building the patterns it is well to set down lines on the floor, just as if one large pattern is wanted, allowing of course for ½ inch of machining on each of the joint plates. These joint plates would be made the total length of the table, the end plates fitting in between, and they would sit on the bottom plate, the bottom plate of the patternmaker being the top plate in the mold. It is advisable that the plate which will be the molders top should cover the edges of the joint and end plates, but the bottom plates should be made to the inside sizes so that when the molder has made the cores and withdrawn the joint and end plates, the bottom plate can be withdrawn readily without tearing the sand.

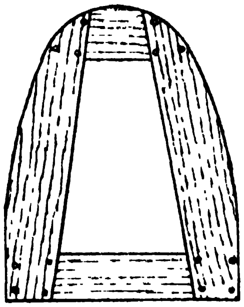


Fig. 6
Template for Arm

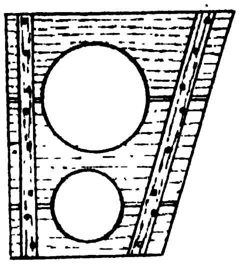
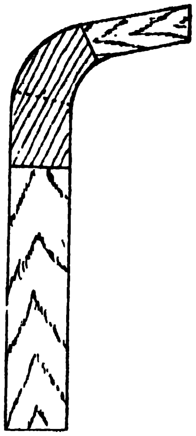


Fig.10
Top Plate

Fig.15



Center Rib
of Arm

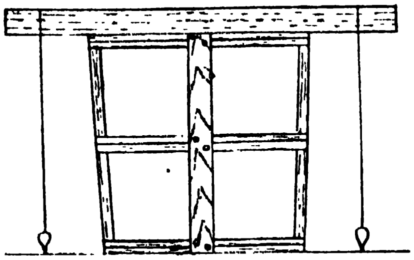


Fig. 7
Testing Barrel before
Lagging is fixed on.

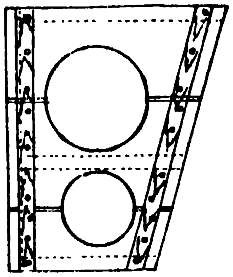


Fig.11
Top Plate

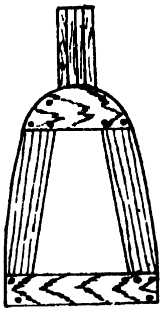


Fig.16

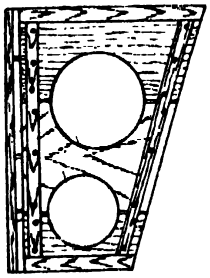


Fig.12
Bottom plate

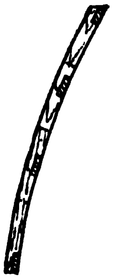


Fig.14

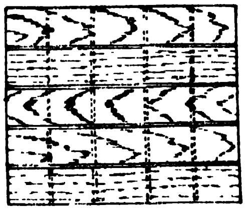


Fig.8
Joint Plate

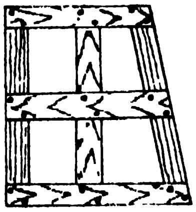


Fig.9
Back and Front
Plates

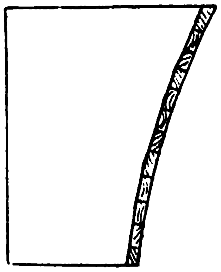


Fig.13
Circular Frame

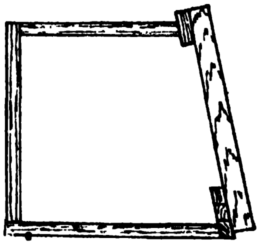


Fig. 17
Building with
Straightedge Gage

FIG. 6—TEMPLET FOR ARM FIG. 7—TESTING BARREL FOR ACCURACY BEFORE AFFIXING LAGGING FIG. 8—JOINT PLATES FIG. 9—BACK AND FRONT PLATES FIG. 10—TOP PLATE FIG. 11—TOP PLATE FIG. 12—BOTTOM PLATE FIGS. 13 AND 14—CIRCULAR FRAMES FIG. 15—CENTER RIB OF ARM FIG. 16—SECTION OF ARM FIG. 17—TRYING OUTER FACE WITH STRAIGHTEDGE

It is well to make the joint plates of two thicknesses as shown in Fig. 8. An open frame could be made but if the end plates are open framed and the molder's top plate has circular holes cut through, the molder has access for ramming up the cores. Whether the joint plates are made of two thicknesses or framed is not material, but it is essential that the center wall of metal *D*, Fig. 1, should not be open.

There are holes through the wall, and it is as well to draw the holes on the plate as a guide for the molder, so that he can draw center lines on one of the large cores and fix on the circular cores. The back and front plates being ordinary half lapped frames like Fig. 9 require no explaining except that like all half lapped plates the joints should be easy to allow for possible swelling of the timber in the mold. The molder's top plate is shown in Fig. 10. Plates with holes in them are usually made open jointed with narrow battens inset to prevent them warping and for convenience in cutting the holes. These are the only recommendations for this method, because they usually shrink too much. Different widths can be screwed together, and after being drawn off each width can be removed and the hole cut with the bandsaw.

Building the Pattern

When all the plates have been finished, the tables may be built in their correct positions on the floor. As was said previously it is nearly always best to build brackets as they will be in the ship. In the case of this bracket however this method would be awkward. A support would have to be made for the center tables and a saddle rest for the barrels, which presents no difficulty but it would be awkward and inconvenient when building the arm, and would consequently take much time. To simplify building the arms, it is better to build with the center table resting on the floor and the barrels in a perpendicular position as shown in Fig. 19.

In building the tables it should be remembered that the molder will have to unscrew them, and all screws should be inserted so that when the pattern is turned upside down he will be able to reach them easily. Thus the bottom plates should be laid on the floor first and temporarily screwed down. The center plate next should be set on and temporary pocket screws inserted. These screws will have to be taken out and replaced by screws through the bottom plate, the molder's top plate that is, prior to sending the job to the foundry. The end plates may be put into position next and blocks, or buttons as they are sometimes called, about 1½ inches square placed inside for fastening them. The plates are heavy, the metal section usually being 2 inches, or 2½ inches, and if the plates are not well screwed when the work is lifted from the floor, the table will not be as rigid as it should be. It is not possible to put in the center ribs until after the arms are finished as they are fitted to [illegible] inside shape of the arm. For the circular holes on the ends of the boxes and on the bottom plate, it is as well to put on prints. Figs. 11 and 12 are views of the finished table looking on the top and bottom respectively.

If there was a dividing wall of metal between the tables and the arm, a two-thickness plate would answer the purpose well; but if the face was twisted owing to the angles of the top and bottom being different, it might be necessary to use narrow widths as shown with the circular face in Fig. 13. With narrow widths no shaping would be required. It is quite common to have a circular instead of a straight face, and if it is not twisted a frame should be used. Half lapped frames for arcs or circles seldom are made in the patternshop, and yet it is good practice and if properly and carefully made will be more reliable than an ordinary straight half lapped frame. Fig. 14 is a view of such a frame. The arc rails unless the frame is small indeed, should be built of segments in about three courses. They should be built wide to allow for finishing afterwards. The straight rails are made in the ordinary way, the necessary convex shape being given to the checks. Even if the radius at the bottom of the frame is different from the radius at the top it does not affect the construction of the frame.

The construction of the arms is a big job. The channel type of arm involves more labor and takes more wood than the fishback type. A great quantity of lumber is unavoidably cut to waste. It is possible to core out these arms, but there would not be a gain of any kind by doing so, at least as much and probably more timber would be used on the pattern and the corebox would be additional. Furthermore, the labor cost would be greater in the coreing process and there would be more uncertainty about thicknesses. There are conceivable circumstances in which a block pattern and corebox might be superior, but almost invariably a shell pattern is best, as with all large shipwork boldness of execution is necessary. Craftsmen with confidence and judgment can have the work done, before perhaps equally skillful but more timid craftsmen have started. Touch and sight are the indispensible tools.

The segmental method should be employed when building the channel arms. It is not possible to use lagging because lugs inside would be inadvisable from the molder's point of view, and there would be the added difficulty of working from the straight part of the arm to the large fillets which connect the arms with the box.

It will be obvious that a platform of some kind is necessary on which to build the arms. Sometimes when there is a dividing plate between the center table and the boss it is more convenient to make the arms by themselves and afterwards fit them into position. This enables more men to be employed on the job. However, when the arms practically form part of the table they cannot be made separately. A suitable building platform is shown in Figs. 19 and 20. Any mistake in the angle will spoil the arms, as it will be quite impossible to rectify it afterwards. The platform must be strongly made, because the weight of the arms which they will have to support will be great. If the arms are divided by cross ribs they may be made and placed in their correct positions on the platform.

Details of the Arms

Pieces like Fig. 15 are needed and should be built of a few thicknesses making five or six inches over all. They should be fitted carefully between the barrels and the center table. When they have been bedded down on the straight edges, they may be removed and planed through with a round-bottom plane. The sides of the arms are built in horizontal layers. Fig. 18 is a section through a finished arm. The widths of each layer are different and have to be taken from the drawing board on which the courses are marked. There is always a tendency to grow when many courses of segments are used and thus the thickness towards top of the arms may not be what it ought to be unless care is taken. It is possible to draw each segment geometrically, but it is more of a task than cutting the lumber to an approximate shape, setting it in its position, drawing it off and finishing. It is not a simple matter to shape these arms. The inside is much more difficult than the outside, because it cannot be seen so readily. The large curves or fillets should remain approximately the same radius, falling over towards the tops of the arms. The best practical way of getting a good shape is to try a bending lath on the surface when each course is laid down. The lath shows little discrepancies and irregularities of the surface.

The lath is an invaluable tool. It should be only about ¼-inch square and whatever length is necessary, and made from straight grained timber. Pine if it is well seasoned makes a good lath, and when a good one is obtained it should be taken care of. The real test of this simple but invaluable tool is when it is bent on various shapes and yet when released springs back straight.

If there are any kinks in it, it should be cast aside as worthless.

Looking at Fig. 1 it is seen that the fillets on one side of the arm project beyond the end plate of the table forming flange *B* and *C*. These flanges are important on the outer faces because the plating is riveted on them. The best way to keep this outer face correct is to use a straight edged gage such as is illustrated in Fig. 17. This is simply a straightedge long enough to bear on the top and bottom plates. At the top a piece *A* of the same thickness should be screwed to the edge.

The arms must be well secured both to the barrels and to the table. As the segments will be 2 inches or 2½ inches thick it is necessary to screw them, but it is only necessary to screw every third or fourth segment to the barrels and the center table. It may be here mentioned that the length of the segment is a matter of judgment a sufficient lap being made for strength.

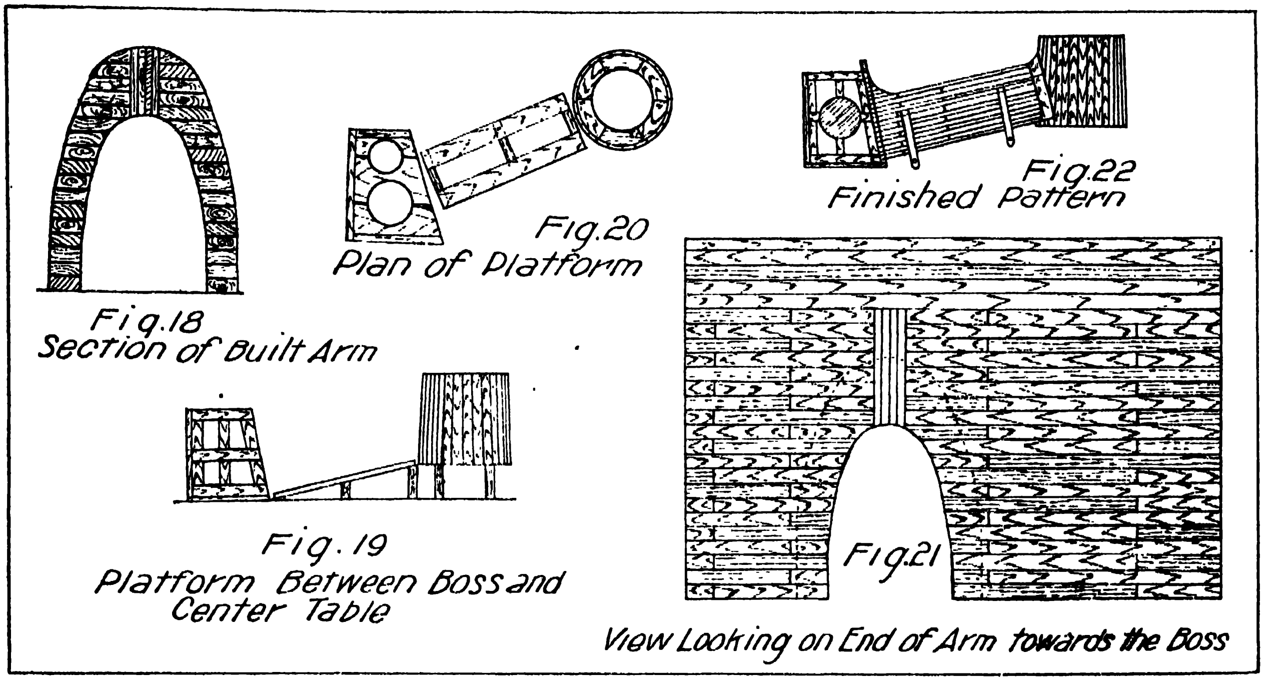


FIG. 18—SECTION OF BUILT UP ARM FIG. 19 PLATFORM BETWEEN BOSS AND CENTER TABLE FIG. 20—PLAN OF ERECTING PLATFORM FIG. 21—VIEW OF THE END OF THE ARM TOWARD THE BOSS FIG. 22—FINISHED DOUBLE ARM BRACKET PATTERN

Fig. 21 is a view of the arm from the table end when it is built and finished. The top five courses are shown running from end to end. This binds the whole work and the number of such courses is determined by the point at which the radius *A*, Fig. 15, is tangent to a line drawn from one end frame to the other. When this point is reached in building, the top built rib must be sawed across and thus a level bed will be formed for the first long piece.

When the arms have been built, it will be necessary to do some finishing on the inside. There are sure to be some lumps and hollows and for this reason the segments should be left about ¼-inch wider on the bend, so that the metal at the finish will not be thin. To finish the inside of the arms, it is best to unscrew them and lift them off the platforms together. Bore holes and drive in pegs from the outside the same length as the required thickness. The craftsman knows that when he touches these pegs he can go no further.

The flanges on the top of the center table, which are really a continuation of the arm metal, present no difficulties if the edges of the top and bottom plates of the table are on the same plane. However, if they are not on the same plane, pieces of thick lumber may be planed to the nearest angle and when the ends at the outer edge have been shaped with the aid of a straightedge, a straight line may be drawn on the top edges. It then will be a simple operation to finish from this line to the bottom edge, after which they can be thicknessed.

Both inner and outer fillets at the barrels should be left loose, that is screwed so that they can be withdrawn separately. The patternmaker sometimes makes a few section pieces for these fillets and leaves the molder to fill between but for all the extra time that it takes up a full fillet in three or four segments is far more satisfactory.

In the finished pattern, Fig. 22, draw straps are shown, by which the molder may haul the arms from the mold. It is almost impossible to devise suitable battens or supports that will keep the barrels or supports from falling away from the arms when the patterns are lifted from the building floor. It probably is safer to send the barrels to the foundry separately, where the pattern may be erected as it will go into the sand. For this purpose the careful craftsman will make a support for the center table as the barrel will rest on the floor.

Constructing the arms that join a division plate is similar, except that instead of cutting the center rib so that lumber may be carried right across, blocks may be fitted or segments at right angles to the other courses of segments and joining the center rib piece. The finish of the fillets on the division plates should be screwed on as separate pieces as the feather edge will stand better if made of side-grained boards.

Slush to Prevent Rust

By H. E. Diller

Question—Please tell us what is used as a slush to prevent machined or bright, chilled surfaces on castings from rusting.

Answer—Vaseline is sometimes used. If a heavier slushing compound is desired, vaseline or mineral oil thickened to the desired degree with rosin can be used. Such a compound is not as easy to remove as is a coating of vaseline, and the more rosin there is in it the more difficulty will be experienced in removing the protective coating. Before applying the compound care should be taken to see that the casting is clean and free from rust.

DATA ON BELTS AND PULLEYS

By W. L. Tryon

ANGLE OF CONTACT

Difference in diameters of pulleys (inches)	Distance between centers of pulleys in inches when angle of contact on smaller pulley is 120°	125°	130°	135°	140°	145°	150°	155°	160°	165°	170°	175°
1	..	....	....	....	....	....	....	....	....	....	....	11.5
2	..	....	....	....	....	....	....	....	....	....	11.5	23
3	..	....	....	....	....	....	....	....	....	11.5	17.2	34.5
4	..	....	....	....	....	....	....	....	11.5	15.3	22.9	46.
5	..	....	....	....	....	....	....	11.6	14.4	19.2	28.7	57.4
6	..	....	....	....	....	....	11.6	13.8	17.3	23.0	34.4	68.7
7	..	....	....	....	....	11.6	13.6	15.1	20.2	26.8	40.2	79.2
8	..	....	....	....	11.6	13.3	15.5	18.5	23.0	30.6	45.9	91.7
9	..	....	....	11.8	13.1	14.9	17.4	20.8	25.9	34.4	51.6	103.1
10	..	....	11.8	13.1	14.6	16.6	19.3	23.1	28.8	38.2	57.4	114.5
11	..	11.9	13.0	14.4	16.1	18.3	21.2	25.4	31.7	42.1	63.1	125.9
12	12	13.0	14.2	15.7	17.5	19.9	23.2	27.7	34.5	45.9	69.8	137.4
13	13	14.1	15.4	17.0	18.9	21.6	25.1	30.1	37.4	49.7	74.6	148.4
14	14	15.2	16.6	18.3	20.4	23.3	27.0	32.4	40.3	53.6	80.3	160.3
15	15	16.3	17.8	19.7	21.8	24.9	29.0	34.7	43.2	57.4	86.1	171.7
16	16	17.4	19.0	21.0	23.3	26.6	30.9	37.0	46.1	61.2	91.8	183.2
17	17	18.4	20.1	22.2	24.8	28.3	32.8	39.3	48.9	65.1	97.5	194.6
18	18	19.5	21.3	23.5	26.2	29.9	34.8	41.6	51.8	68.9	103.3	205.1
19	19	20.6	22.5	24.8	27.7	31.6	36.7	43.9	54.7	72.7	109.0	217.5
20	20	21.7	23.7	26.1	29.2	33.3	38.6	46.2	57.6	76.6	114.7	229.0
21	21	22.8	24.9	27.4	30.7	35.0	40.5	48.5	60.5	80.4	120.5	240.4
22	22	23.9	26.2	28.7	32.1	36.6	42.5	50.8	63.4	84.2	126.2	251.9
23	23	24.9	27.4	30.0	33.6	38.3	44.4	53.1	66.3	88.1	132.0	263.3
24	24	26.0	28.5	31.3	35.1	40.0	46.3	55.4	69.1	91.9	137.7	274.8
25	25	27.1	29.7	32.7	36.5	41.6	48.3	57.7	72.0	95.7	143.4	286.2
26	26	28.2	30.9	34.0	38.0	43.3	50.2	60.1	74.9	99.6	149.2	297.7
27	27	29.3	32.1	35.3	39.5	45.0	52.1	62.4	77.7	103.4	154.9	309.1
28	28	30.3	33.3	36.6	40.9	46.5	54.1	64.7	80.6	107.2	160.6	320.6
29	29	31.4	34.4	37.9	42.4	48.2	56.0	67.0	83.5	111.0	166.4	332.0
30	30	32.5	35.6	39.2	43.9	49.8	57.9	69.3	86.4	114.9	172.1	343.5
31	31	33.6	36.8	40.5	45.3	51.5	59.9	71.6	89.3	118.7	177.8	.....
32	32	34.6	38.0	41.8	46.8	53.2	61.8	73.9	92.2	122.5	183.6	.....
33	33	35.7	39.2	43.1	48.3	54.8	63.7	76.2	95.1	126.4	189.3	.....
34	34	36.8	40.3	44.4	49.7	56.5	65.7	78.5	97.9	130.2	195.1	.....
35	35	37.9	41.5	45.8	51.2	58.2	67.6	80.8	100.8	134.0	200.8	.....
36	36	39.0	42.7	47.1	52.7	59.8	69.5	83.2	103.7	137.8	206.5	.....
37	37	40.0	43.9	48.4	54.1	61.5	71.5	85.5	106.5	141.7	212.3	.....
38	38	41.1	45.1	49.7	55.6	63.2	73.4	87.8	109.4	145.5	218.0	.....
39	39	42.2	46.3	51.0	57.0	64.8	75.3	90.1	112.3	149.3	223.7	.....
40	40	43.3	47.3	52.3	58.5	66.5	77.3	92.4	115.2	153.2	229.4	.....

(Concluded on Data Sheet No. 308)

DATA ON BELTS AND PULLEYS

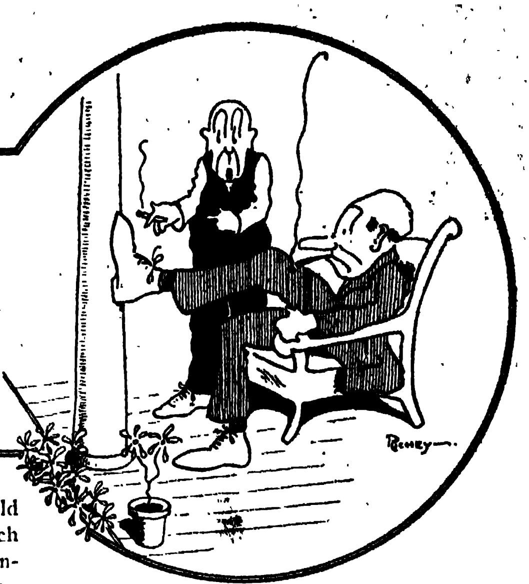
By W. L. Tryon

(Concluded from Data Sheet No. 307)

Difference in diameters of pulleys (inches)	Distance between centers of pulleys in inches when angle of contact on smaller pulley is 120°	125°	130°	135°	140°	145°	150°	155°	160°	165°	170°
41	41	44.3	48.5	53.6	60.0	68.2	79.2	94.7	118.1	157.0	235.2
42	42	45.4	49.7	54.9	61.4	69.8	81.1	97.0	121.0	160.9	241.0
43	43	46.5	50.9	56.2	62.9	71.5	83.1	99.3	123.9	164.8	246.7
44	44	47.6	52.0	57.5	64.3	73.2	85.0	101.6	126.8	168.6	252.4
45	45	48.7	53.2	58.8	65.8	74.8	86.9	104.0	129.7	172.5	258.2
46	46	49.8	54.4	60.1	67.3	76.5	88.9	106.3	132.6	176.3	263.9
47	47	50.9	55.6	61.4	68.7	78.2	90.8	108.6	135.4	180.1	269.6
48	48	52.0	56.8	62.7	70.2	79.8	92.7	110.9	138.3	183.9	275.4
49	49	53.1	58.0	64.0	71.6	81.5	94.7	113.2	141.2	187.7	281.1
50	50	54.2	59.2	65.3	73.1	83.2	96.6	115.5	144.1	191.5	286.9
51	51	55.2	60.3	66.7	74.6	84.8	98.5	117.8	147.0	195.4	292.6
52	52	56.3	61.5	68.0	76.0	86.5	100.5	120.2	149.9	199.2	298.3
53	53	57.4	62.7	69.3	77.5	88.2	102.4	122.5	152.8	203.0	304.1
54	54	58.5	63.9	70.6	78.9	89.8	104.3	124.8	155.7	206.9	309.8
55	55	59.6	65.1	71.9	80.4	91.5	106.3	127.1	158.5	210.7	315.5
56	56	60.7	66.3	73.2	81.9	93.2	108.3	129.4	161.4	214.5	321.3
57	57	61.7	67.4	74.5	83.3	94.8	110.1	131.7	164.2	218.4	327.0
58	58	62.8	68.6	75.8	84.8	96.5	112.1	134.0	167.1	222.2	332.7
59	59	63.9	69.8	77.1	86.2	98.2	114.0	136.3	170.0	226.0	338.5
60	60	65.0	71.0	78.4	87.7	99.8	115.9	138.6	172.8	229.8	344.2
61	61	66.1	72.2	79.7	89.2	101.5	117.9	140.9	175.7	233.7	.....
62	62	67.2	73.4	81.0	90.7	103.2	119.8	143.3	178.6	237.5	.....
63	63	68.2	74.5	82.3	92.1	104.8	121.7	145.6	181.4	241.3	.....
64	64	69.3	75.7	83.6	93.6	106.5	123.7	147.9	184.3	245.2	.....
65	65	70.4	76.9	84.9	95.1	108.2	125.6	150.2	187.2	249.0	.....
66	66	71.5	78.1	86.2	96.5	109.8	127.5	152.5	190.1	252.8	.....
67	67	72.6	79.3	87.5	98.0	111.4	129.5	154.8	192.9	256.6	.....
68	68	73.6	80.4	88.8	99.5	113.1	131.4	157.1	195.8	260.5	.....
69	69	74.7	81.6	90.1	100.9	114.7	133.3	159.4	198.7	264.3	.....
70	70	75.8	82.8	91.5	102.4	116.4	135.2	161.7	201.6	268.1	.....
71	71	76.9	84.0	92.8	103.9	118.0	137.1	164.0	204.5	271.9	.....
72	72	78.0	85.2	94.1	105.3	119.7	139.0	166.3	207.4	275.8	.....
74	74	80.1	87.5	96.7	108.2	123.0	142.9	170.9	213.1	283.4	.....
76	76	82.3	89.9	99.3	111.2	126.3	146.7	175.5	218.9	291.1	.....
78	78	84.4	92.2	101.9	114.1	129.7	150.6	180.2	224.6	298.7	.....
80	80	86.6	94.6	104.5	117.0	133.0	154.5	184.8	230.4	306.4	.....
82	82	88.8	97.0	107.1	119.9	136.3	158.4	189.4	236.2	314.1	.....
84	84	90.9	99.3	109.7	122.8	139.7	162.2	194.0	241.9	321.7	.....
86	86	93.1	101.7	112.3	125.8	143.0	166.1	198.6	247.7	329.3	.....
88	88	95.3	104.0	115.0	128.7	146.3	170.0	203.3	253.4	337.0	.....

Bill Has a Word on the Column Proposition

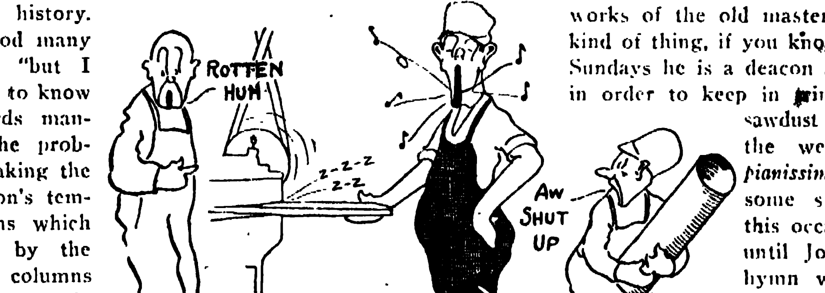
BY PAT DWYER



WHILE sitting on Bill's verandah one Sunday afternoon recently, I commented in an idle way on the extraordinary size of the columns supporting the porch roof. That little innocent remark started a discussion on columns which would be going yet if Bill's wife had not called him in to mind the baby while she fixed her hair.

I ventured the opinion that all columns under 16 feet long should be cast on end like water pipe Bill dodged the argument, preferring to allow his mind to wander back into ancient history. "I have made a good many columns," said he, "but I would certainly like to know how those old birds managed. Think of the problems involved in making the columns for Solomon's temple; or the columns which Sampson tore up by the roots or the 55-foot columns which Jim Floyd cast in New York for the elevated railroad back when we were kids." I said there was a lot of difference between making columns in a house work shop and a jobbing shop. "You said something that time," said Bill. "Whenever I hear of columns it reminds me of an experience I had in a place I worked one time. They used to make quite a number of columns in the run of a year. Several wooden flasks were in existence but between poor design in the first place and exposure to the weather in the second they were regular 'baskets.' It did not make so much difference in the short lengths, as by exercising particular care castings could be made in them. The long flasks however were hopeless. Rolling the cope over pulled the flask out of line and when the casting was made and lifted out in the morning the joint would be matched perfectly at each end but would show a considerable shift in the center. Of course it could be chipped, but it meant a lot of extra work and the casting always had a second hand lopsided appearance even after it was finished.

"The owner of the foundry was no better pleased than I but was firmly convinced that the shift was the result of carelessness on the part of the molder. I told him that if we had a solid-iron cope we could get straight, perfectly matched castings irrespective of the molder's carlessness. During one of these discussions he intimated that I might go ahead and make an iron cope the next slack spell we had.



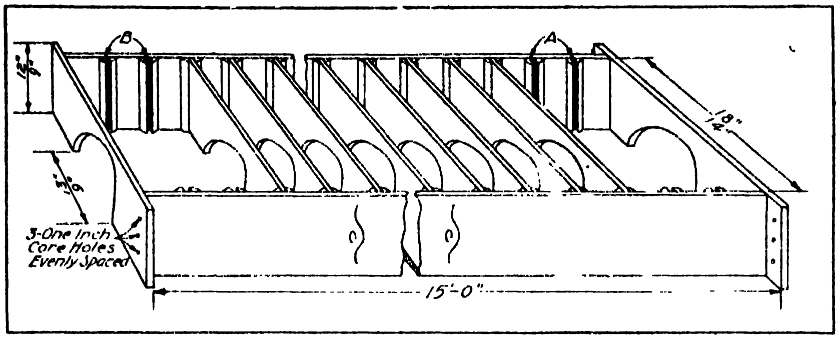
HE LACKED THE COURAGE TO SING OPENLY

"When I want a thing done I can generally find an opportunity of doing it. I went over to the pattern shop to try and interest my old friend John in the proposition. I found him running some boards through the pony planer and singing at the top of his voice. He loves to sing but lacks the courage to do it openly or without a disguise of some sort. The noise of the planer affords him protection, but even as thus handicapped I have seen the man on the next bench give him a hard look on occasions.

"John is one of the 'life is real, life is earnest' class of human beings and therefore he does not carol gaily the frothy nothings which pass for songs in this day and generation. Not at all. Far from it. He employs his talent exclusively in interpreting the works of the old masters, cantatas and that kind of thing, if you know what I mean. On Sundays he is a deacon and choir leader and in order to keep in trim he coughs up the sawdust a few times during the week and runs over *pianissimo* a verse or two of some standard hymn. On this occasion I stuck around until John had finished the hymn which he did simultaneously with passing the last board through the planer. I waited until he had shut off the power and there was some chance of making myself heard. 'John,' I said, 'if you can spare me a minute of your valuable time I wish to say a few words of the utmost importance.' 'Nothing doing,' said he, 'I never lend anybody anything.' 'All I want you to lend me,' I said, 'is your ears. Heaven knows they are long enough and sharp enough and hairy enough to account for you being such a kicker. I don't want to keep them, I merely wish to enlist your sympathy and co-operation in producing certain results which I now have under consideration.' 'If you will kindly cut the queer stuff,' said he, 'and the personal allusions, and say briefly what you have to say, I'll see about it. Your conscience may allow you to come over here wasting your time, but I have work to do.'

"'John,' I said, 'your words do you credit. They show that you have a strong conscience but a weak heart. You jump to conclusions too quickly. I am not wasting my time. 'Tis true I am not actively engaged in wrestling with the world, the flesh and the devil, but I am trying to give the man who employs me a fair return on his investment. I am thinking of changing our practice for making columns. The proposed change will save time, will eliminate drops and crushes, will assure straight castings and above all, the joint of the casting will not be disfigured by a half inch shift along the middle. Now in view of all these benefits, don't you think that your expressed opinion of me is a little harsh and unchristian-like, to say the least?'

"'I still fail to see where all this bunk interests me,' said he. 'Why John,' I said, 'I am surprised; your nimble mind is generally able to jump across all the preliminary steps, but if you insist on a full and detailed statement, here it is, viz., i. e. to wit, as follows:



BILL AND JOHN CONTRIVED AN EXTENSIBLE COPE

"'I wish to make a couple of iron copes and since I cannot make them without a pattern of some kind I would now respectfully beg, plead, urge, cajole, coax, threaten, persuade or otherwise request that you provide, build, make, fabricate, manufacture, produce and deliver a suitable pattern or patterns for the aforesaid purpose.' 'Oh,' said he, 'boil it down; cut it short. Give me something definite. What do you want?' 'All right,' I said, 'cock your long ears and pay attention. I want two solid iron copes each 15 feet long. One with the bars cut out to accommodate columns 12 inches in diameter and the other cut out for columns 8 inches in diameter. With these two flasks we can make any size from 4 to 12 inches. They are to be open at the ends, that is the end pieces of the flasks will be the same as the bars. I want two vertical flanges at each end with three 1-inch cored holes in each. These are for the purpose of attaching extension pieces in case we have to make columns over 15 feet long. We will leave two bars out near each end but provide sockets in which we can wedge wooden bars in case we get a column with an elaborate base. We will put the handles on with cores, two on each side. Now there you are, is that clear and explicit enough?'

"'Oh, sure,' said he, 'with the exception that you did not say what the height or width was going to be, or what thickness you wanted the sides and bars and vertical flanges at the ends; or whether you need a complete pattern or can get along with a set of loose pieces. With these few exceptions the explanation is clear.'

"'Well, now John, I'll tell you,' I said, 'I could have worked out all those details but I thought it might afford you a certain amount of pleasure to work them out for yourself.' 'Beat it,' said John, 'you not only expect me to make the pattern but you also want me to design it, the next thing I know you will want me to go over to the foundry and mold the job for you.' 'Don't be alarmed,' I said. 'It takes a real man with hair on his chest like a billy goat to make a mold. If you will let me have one of your numerous pencils for a minute I will make you a sketch and furnish full specifications.'

"I selected a nice fat red pencil from his pocket and picked up one of the boards which he had just planed to thickness with the laudable intention of making a sketch on it. He let out a howl like I had stepped on his toe and said: 'Here, drop that, there are lots of pieces of lumber lying around without taking a piece that I am just going to use.' I told him not to speak to me so rudely and roughly or I would go back to the foundry where none of that rough stuff was allowed in order to finish the job. 'Go ahead,' said he, 'you can't go too quick or too soon to suit me.'

"It was a bitterly cold day so I left the door open purposely when I went out. I knew from experience that nothing aggravated him so much as for someone to do that. When I was about half way back to the foundry I had the pleasure of hearing the door slam so I knew the measures were effective.

"I made a sketch and took it over to him the next day. He wanted to know what all the figures were for. I explained to him that the supply of stationery in my ebony and ivory escritoire was all gone when I went to look, with the exception of one sheet so I had to make the one sketch do for the two copes. The design was the same for both and I had marked both sets of dimensions.

"'Pretty rough work,' said he, 'but what could one expect from a molder?' I told him I did not know what one expected but I knew what one usually got if one aired his opinions too freely in the molder's presence and hearing. 'Personally,' I said, 'I am opposed to violence and the shedding of human blood but I sometimes make exceptions in favor of patternmakers and others who have no friends.'

"'If I can get a seconder,' said John, 'I move you that we suspend the regular order of procedure and go back to "unfinished business." Under that heading we can take up the consideration of your flask which I now see has several very meritorious features.

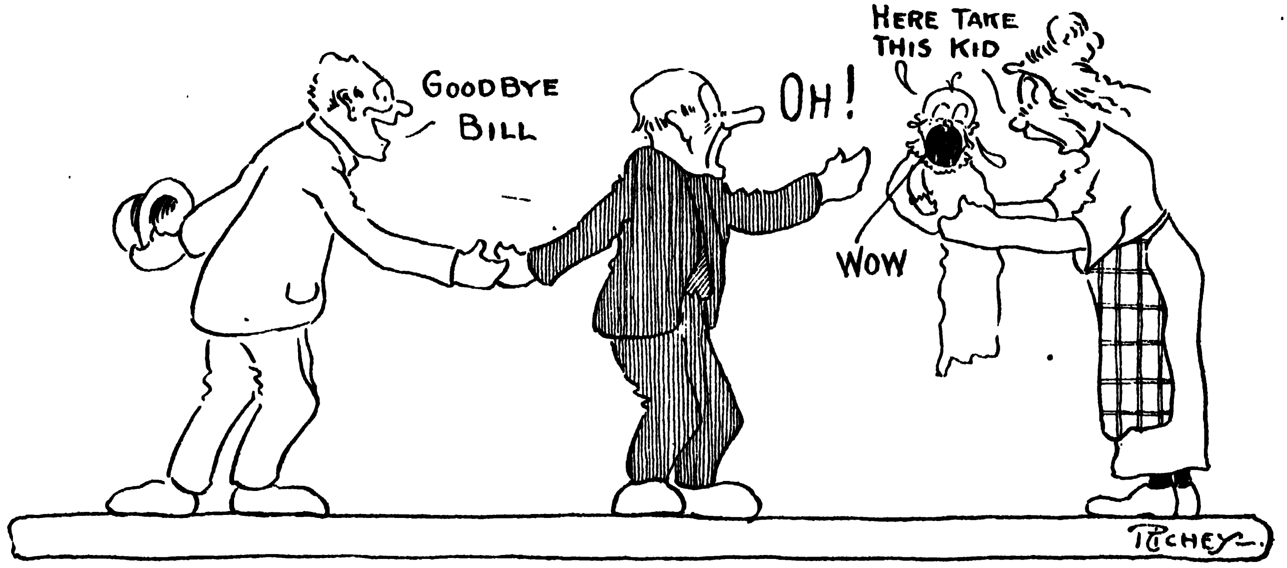
"I never refuse to grab the olive branch when it is held out to me. 'Don't say "your flask,"' I said, 'say "our flask" for I realize that your share of the job is the more important of the two.'

"Having sprinkled these few kind words, like the balm of Gilead, I left, carefully closing the door.

"John brought the pieces for the pattern over the next day and as I had expected they were better than the ones I had doped out in my own mind. Each side piece was 6 feet long and he had nailed a pair of heavy fillets at each place to locate the bars. They are shown at *A* and *B* in the sketch. The end pieces and vertical flanges were held in place with screws. Four loose bars were provided. We dug a hole, 17 x 1 x 3 feet, in the foundry floor and with the aid of a line and level bedded in bricks at convenient intervals to serve in locating the pattern each time it was shifted. The rest of the job was a matter of routine.

"We set the pattern on the first set of bricks, dropped the four loose bars into their places, leaving the two end spaces clear; set up two handle cores, one on each side and rammed it up, inside and out. We had to shift the bars as we went along and to insure the sand between bars standing up after the patterns were removed a row of soldiers was rammed up in each space. We removed the screws from the end pieces, one at each ramming and when the mold was rammed to the top, we drew the pattern one piece at a time.

"The pattern was assembled again and dropped into place by letting the two free ends lap into the mold the width of one bar. The pattern was rammed for a distance of about 4 feet and drawn out again. The next time it was set to make the total length, the second pair of handle cores were placed and the rest of the mold rammed up and finished.



NO MAN CAN CARRY BOTH A BABY AND A CONVERSATION AT ONE TIME

"Instead of pouring the job at both ends at the bottom we made up a long basin on one side and poured it from the top, letting the iron enter about a dozen bars at one time. We made the smaller cope in the same way the following day and afterward we made two extension pieces for each of them; and, believe me, after that we had no more shifted columns."

At this point, as I remarked before, Bill's wife asked him to hold the baby and I knew it was time for me to move. A woman can hold a baby and carry on a conversation at the same time but I never saw a man who could do it cheerfully and get away with it. Of course if it is a well trained baby, one of these eugenic babies you read of in the papers every once in a while, which eats and plays and sleeps on a stop watch schedule it might be done, but Bill's baby was not one of that kind.

Making Short Drums from Long Patterns

By Mollison Herbert

A standard drum 48 inches long was designed to be molded on end. It was provided with a 3-inch flange, top and bottom. The top flange was attached firmly to the pattern while the bottom flange was loose. An unexpected emergency made necessary the production of a drum similar in all respects to the standard, except that the length desired was 23 instead of 48 inches. This drum was made from the standard pattern in the following manner:

A hole was dug in the floor approximately three-fourths the depth of the pattern or in other words deep enough to allow 12 inches of the pattern to project above the floor level. The pattern was placed in the hole, trued up and leveled but no attempt was made to get any impression of the bottom hub. Sand was filled in around the pattern and the hole rammed up flush with the floor. A straight edge with a piece 12 inches long depending from one end of it was used to strike a level parting around the pattern. This parting was slicked, parting sand thrown on and a cheek 12 inches deep placed around the pattern. The cheek was rammed flush with the top of the pattern, a parting made and a cope set on. The cope was rammed and lifted off, then the pattern was drawn and the cheek lifted off.

The pattern was then taken and bedded properly in the floor in a new place. A parting was made flush with the top side of the loose flange. Now since there was a cheek 12 inches deep already rammed up and the required casting was to be 23 inches, it followed that another cheek 11 inches deep would be sufficient. Accordingly a cheek the required depth was set on and rammed up and a parting made using the top face of the cheek frame for a guide. The pattern was then drawn, the cheek taken off and the lose ring pattern removed. After the mold was finished and blacked it was assembled by putting the last cheek on first, then the other.

Long Prints Not Needed on Pipe Bends

By M. E. Duggan

Cutting four half core prints from 2-inch stock and fastening them to a pattern is a simple and easy job for the patternmaker; but gluing up stock, turning the four half prints, cutting the recesses, fitting and fastening the prints in the pattern, means labor, time and material and adds to the cost of the pattern especially for a single casting.

There is a difference of opinion among molders and patternmakers regarding the proper length of core prints on pipe bend patterns. Some are in favor of long prints while others are in favor of short prints. I have never met a man, patternmaker or molder who could convince me that short prints were contrary to good molding practice because I have seen good castings made every day from such patterns.

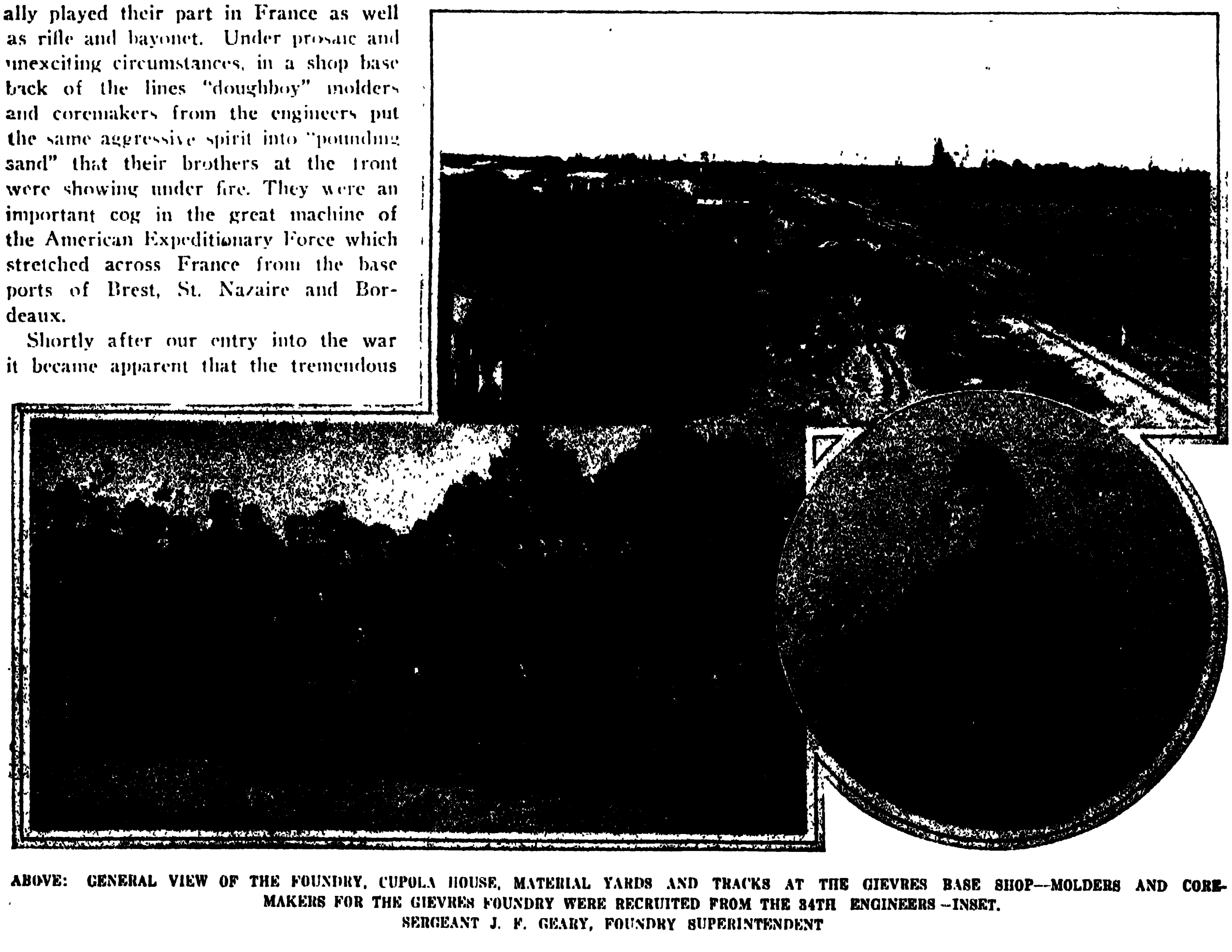
The question resolves itself into two phases which may be briefly summarized. The short prints give satisfactory results provided they rest in rigid bearings and chaplets are provided top and bottom in the center of the bend to hold the core in position before and during the casting operation. This applies to both large and small pipes. The only advantage of using long prints is that small bends need no chaplets.

How the Foundry Served Overseas

Immediate and Pressing Need of Repairs for Guns, Mounts, Tractors, Locomotives, Tanks and Machines of All Kinds Demand the Establishment of Foundry Facilities in France

Practically every military branch which composed the A. E. F. has reported its particular task and recounted how each duty was well performed. On the eve of the first anniversary of the armistice, it is permitted to detail the work of that unit which formed the outpost of the American foundry industry overseas, a unique link between the army in the field and the industrial forces at home.

EVERYONE knows that the foundry industry at home "did its bit" toward victory in a direct way by its work on guns and munitions, and in a less direct but equally important way by aiding the manufacture of a tremendous amount of mechanical equipment that was necessary to transport, feed, equip and support the army across the sea. Few, however, know that besides fulfilling important tasks at home, the foundry actually threw its outposts overseas and that shovel and rammer actually played their part in France as well as rifle and bayonet. Under prosaic and unexciting circumstances, in a shop base back of the lines "doughboy" molders and coremakers from the engineers put the same aggressive spirit into "pounding sand" that their brothers at the front were showing under fire. They were an important cog in the great machine of the American Expeditionary Force which stretched across France from the base ports of Brest, St. Nazaire and Bordeaux.



ABOVE: GENERAL VIEW OF THE FOUNDRY, CUPOLA HOUSE, MATERIAL YARDS AND TRACKS AT THE GIEVRES BASE SHOP—MOLDERS AND COREMAKERS FOR THE GIEVRES FOUNDRY WERE RECRUITED FROM THE 34TH ENGINEERS—INSET. SERGEANT J. F. GEARY, FOUNDRY SUPERINTENDENT

Shortly after our entry into the war it became apparent that the tremendous amount of mechanical equipment sent abroad would require extensive repair facilities and that the French industrial organization, with its depleted personnel, could lend no aid. The engineer corps, therefore, made up a comprehensive plan of repair shops with a proposed base shop at Gievres (*Loir et Chere*) which was a center of activities in the service of supplies as the principal and largest supply depot. This base was to be known as General Intermediate Depot No. 1. As planned it was to consist of six buildings, each 50 x 500 feet. The operating force was set at 750 men. One of the six buildings planned was to be a foundry while a pattern shop was to occupy part of another. Further, there was to be an advance shop at Is-sur-Tille (*Cote d'Or*) where an advance supply depot of approximately the same capacity was to be located, this also was to include a foundry. It was planned to establish with each army in the field one semipermanent metal and wood shop for mechanical work only and five small advance shops. The original specifications for the small advance shops stated that they were to be placed as closely as possible to the front line trenches and that "Shell fire is to be a secondary consideration." However, portable shops on motor trucks were substituted later for the small advance shops.

Practically all of this general plan was executed before the armistice, but for obvious reasons the mechanical parts of the different shops were given first attention. The first engineer machine shops at Is-sur-Tille commenced operations on a small scale about the end of March, 1918, and fairly complete wood and metal repair shop at the Gievres base plant commenced operations June 27, but it was not until July 24 that the foundry building at Gievres, was completed by the civilian contractor and turned over to the engineers.

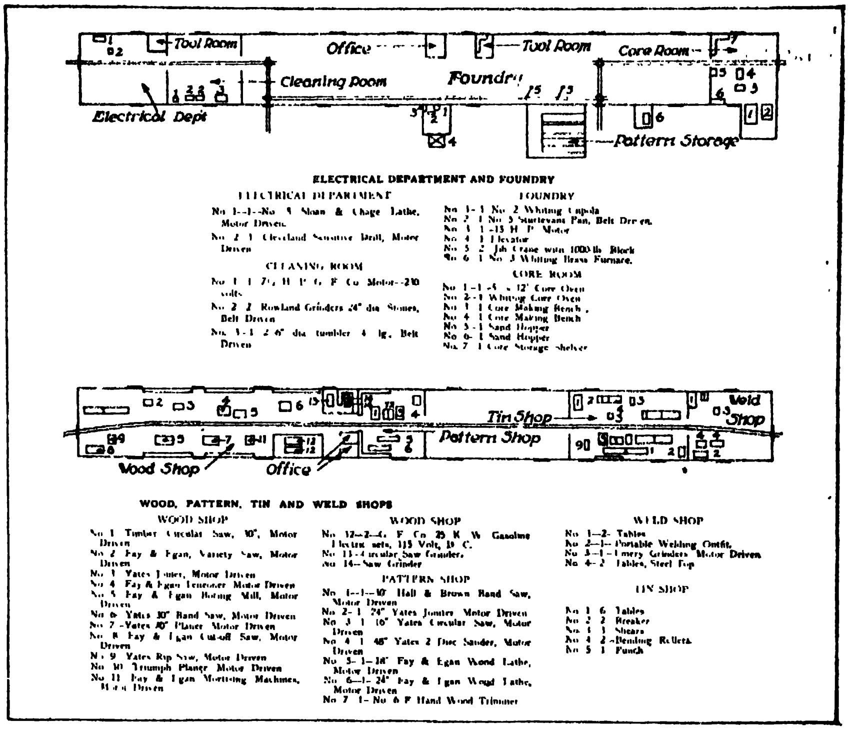
The foundry building, 50 x 500 feet, was one of the standard type light steel frame covered with corrugated iron used in large number in France for warehouses. It followed standard construction in the small ventilators and windows placed high under the eaves and this made it necessary to remodel the building to adapt it to foundry needs. A liberal number of pipe ventilators was put in the roof and swinging window frames covered with oiled cloth (glass was nearly as extinct as the dodo "over there") in the side walls.

On account of the narrowness of the building (50 feet) it was not considered advisable to have cupola, core room, pattern vault or brass furnace inside the building. Accordingly structures were added along one side to house these as shown in the accompanying plan.

The floor was rough and the furrows left by a potato patch which was flourishing when erection started made it necessary to grade over the entire floor area. A pocket of tough clay was discovered just outside the foundry building and a top surface of this wet clay tamped smooth and hard gave a floor almost as good as concrete.

A narrow gage track was laid directly in front of the cupola along the full length of the foundry. This made it possible to handle iron to any floor in large geared truck ladles of 2000 pounds capacity. This same track connected with a complete system covering the foundry material yard, extending to the charging platform and through and around all of the other shops in the group.

A cupola built by the Whiting Found-



ELECTRICAL DEPARTMENT AND FOUNDRY

ELECTRICAL DEPARTMENT

No 1—1—No 9 Sloan & Chace Lathe, Motor Driven.
No 2 1 Cleveland Sensitive Drill, Motor Driven

CLEANING ROOM

No 1 1 7½ H P G E Co Motor—220 volts
No 2 2 Rowland Grinders 24" dia Stones, Belt Driven
No. 3-1 2 6" dia tumbler 4 lg. Belt Driven

FOUNDRY

No 1-1 No 2 Whiting Cupola
No 2 1 No 5 Sturtevant Fan, Belt Driven
No 3 1-15 H P Motor
No 4 1 Elevator
No 5 2 Jib Crane with 1000-lb Block
No 6 1 No 3 Whiting Brass Furnace.

CORE ROOM

No 1—1 -5 x 12' Core Oven
No 2-1 Whiting Core Oven
No 3 1 Core Making Bench.
No 4 1 Core Making Bench
No 5-1 Sand Hopper
No 6-1 Sand Hopper
No. 7 1 Core Storage shelves

WOOD, PATTERN, TIN AND WELD SHOPS

WOOD SHOP

No 1 Timber Circular Saw, 30", Motor Driven
No 2 Fay & Egan, Variety Saw, Motor Driven
No 3 Yates Jointer, Motor Driven
No 4 Fay & Egan Tenoner Motor Driven
No 5 Fay & Egan Boring Mill, Motor Driven
No 6 Yates 30" Band Saw, Motor Driven
No 7 -Yates 30" Planer Motor Driven
No 8 Fay & Egan Cut-off Saw, Motor Driven
No 9 Yates Rip Saw, Motor Driven
No 10 Triumph Planer Motor Driven
No 11 Fay & Egan Mortising Machines, Hand Driven

WOOD SHOP

No 12—2—G. E Co 25 K W Gasoline Electric sets, 115 Volt, D C.
No 13—Circular Saw Grinder.
No 14—Saw Grinder

PATTERN SHOP

No 1—1—30" Hall & Brown Band Saw, Motor Driven
No 2-1 24" Yates Jointer Motor Driven
No 3 1 16" Yates Circular Saw, Motor Driven
No 4 1 48" Yates 2 Disc Sander, Motor Driven
No 5-1—18" Fay & Egan Wood Lathe, Motor Driven
No 6—1—24" Fay & Egan Wood Lathe, Motor Driven
No 7 1—No 6 F Hand Wood Trimmer

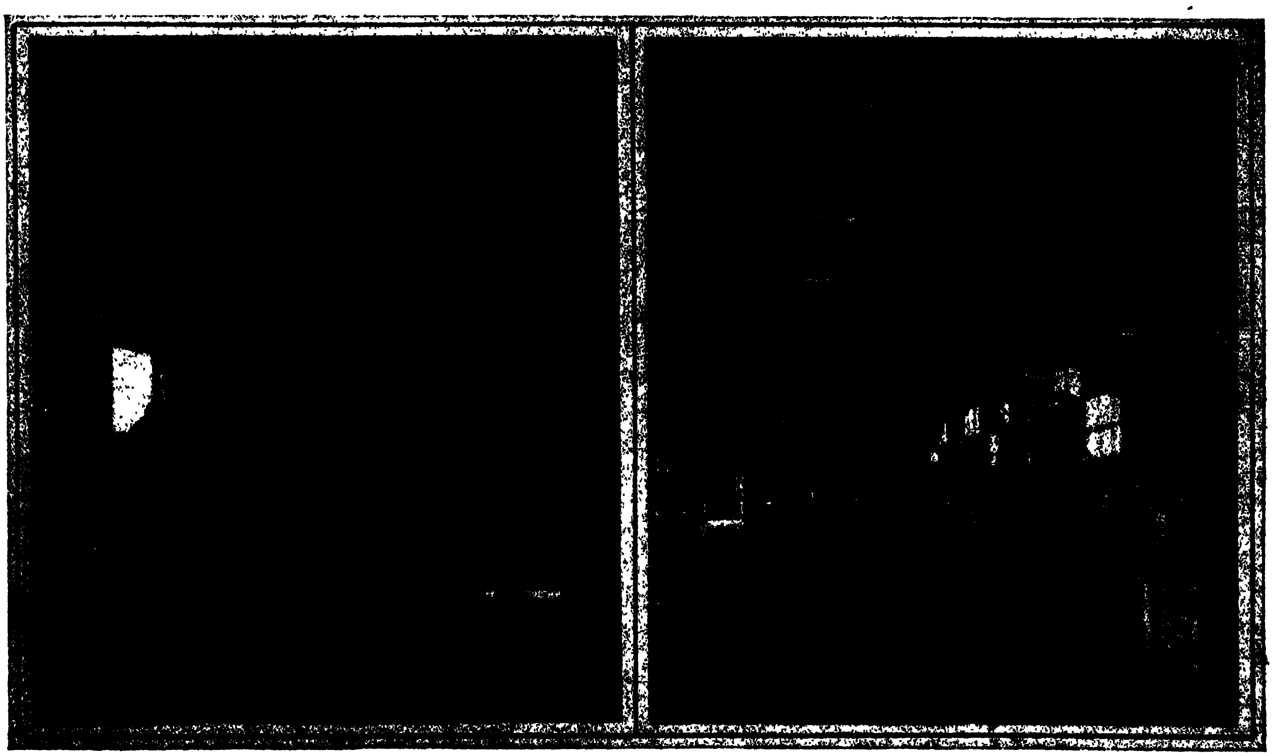
WELD SHOP

No 1—2- Tables
No 2—1—Portable Welding Outfit.
No 3—1—Emery Grinders Motor Driven
No 4-2 Tables, Steel Top

TIN SHOP

No 1 6 Tables
No 2 2 Breaker
No 3 1 Shears
No 4 2—Bending Rollers
No 5 1 Punch

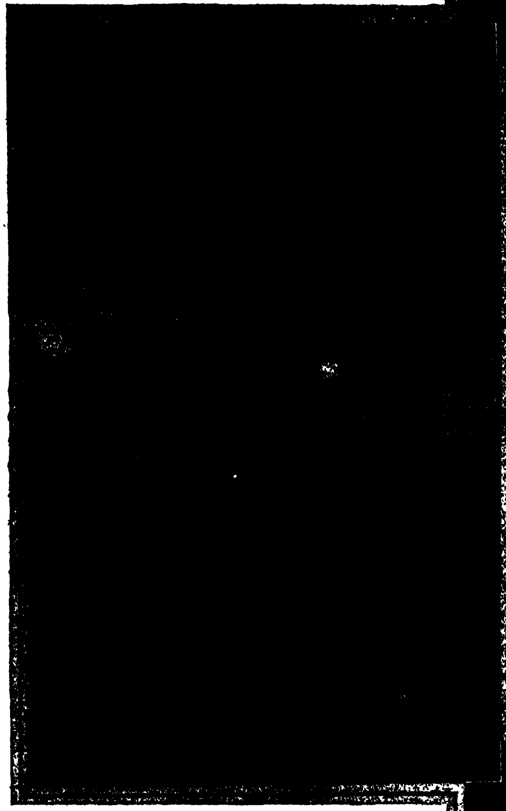
DETAILS OF FOUNDRY AND PATTERN SHOPS AT GIEVRES



THE CUPOLA WAS SET IN A SEPARATE BUILDING JUST OUTSIDE THE MAIN FOUNDRY FLOOR AND TRUCK LADLES RECEIVED THE METAL TAPPED—GENERAL VIEW OF THE WEST END OF THE FOUNDRY FLOOR ry Equipment Co., Harvey, Ill., with a rated capacity of two tons per hour was installed. This was blown with a fan made by the B. F. Sturtevant Co., Boston.

Iron, coke and limestone were loaded upon cars in the foundry yard and lifted to charging platform on a power elevator. The charging platform had a floor of ¼-inch steel plates and the narrow gage storage tracks and turntables were so arranged that iron could be charged directly into cupola from cars, preventing rehandling from yard to cupola.

MOLDING SAND WAS UNLOADED FROM BARGES BROUGHT ON THE CANAL—SERGEANT ADAMS, ASSISTANT FOUNDRY SUPERINTENDENT IN THE FOREGROUND



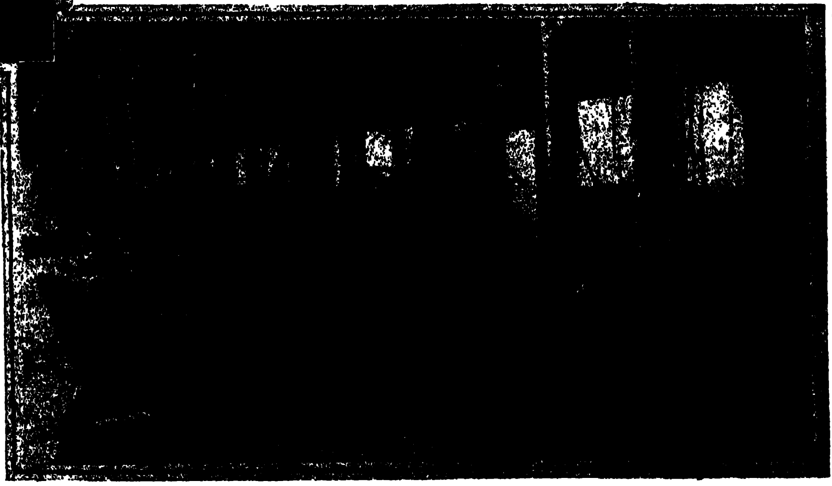
WALL CRANES WERE CONVERTED TO PILLAR CRANES TO COMMAND THE TRACKWAY AND POURING FLOORS

The core oven equipment was a rolling shelf oven with five shelves or drawers. Only the shelves and their supporting frames were furnished from the States and of course it was necessary to design and build a brick fire box and setting. A 5 x 12-foot truck oven was completed just before the armistice to handle any larger core work which might be required later.

The cleaning room was equipped with two heavy English-made double wheel grinders carrying 3 x 24-inch grinding wheels, and a tumbling barrel, 2½ feet in diameter by 4 feet long.

One Whiting nonferrous furnace, coke fired, was installed in a separate building alongside the foundry to melt the brass and aluminum required.

For handling heavy work in the foundry, there were two cranes of 8-foot radius remodeled in the shops from wall type to pillar type in order to allow them to cover a full circle. These were rated at about 1½ tons and were set to swing over the narrow gage track so that the large ladles could be lifted out of their trucks and poured from the crane. All flasks and bottom boards including snap flasks for bench work and specially designed coremakers' tables, molders' benches and brass molders' tubs were built in the shops. A few steel flasks ordered from American manufacturers were in use.



A COMPLETE MACHINE SHOP WHICH FORMED A PART OF THE BASE SHOP SUPPLEMENTED THE WORK OF THE FOUNDRY DEPARTMENT AT GENERAL INTERMEDIATE SUPPLY DEPOT NO. 1

As previously stated, the building was turned over on July 24, 1918. On Sept. 17 the first brass heat was poured and Sept. 20, a little less than two months after taking over the building, the first heat of gray iron was poured. The foundry was at that time completely equipped as described and shown in the illustrations which were taken from photographs taken during operations.

It was at this time the only gray-iron foundry completed and in operation by the army overseas. A fully equipped pattern shop was in operation. The foundry was ready to meet all requirements for gray iron, brass and aluminum castings and orders were on hand for a considerable amount of work for the army.

The shop personnel consisted of skilled molders and coremakers from the thirty-fourth engineers, a regiment specially organized to operate the engineer shops and depots. The foundry and all shop activities at Gievres were under the general charge of Lieut. Col. Smitten of this regiment. Sergeants

J. F. Geary and Samuel C. Hardman, detached from the eleventh engineers after six months service on the British front before Cambria, planned and executed the design of the foundry and its equipment. Sergeant Geary had charge of foundry operations until its closing after the armistice with Sergeant Adams of the thirty-fourth engineers as assistant.

In the short time it was in operation, the foundry turned out about 6 or 7 tons of brass castings and 70 to 75 tons of gray iron castings, covering a wide range of work, such as pulleys and hangers, parts for antiaircraft searchlight mounts and repair parts for locomotives, motor trucks, tanks, tractors and machinery of all sorts.

Cast-Iron Shoe Last Made in a Two-Part Flask

Question—We are forwarding sample of a shoe last which we have up to now been making in our foundry by hand. We wish to increase our output to 300 tons or about 80,000 lasts per year.

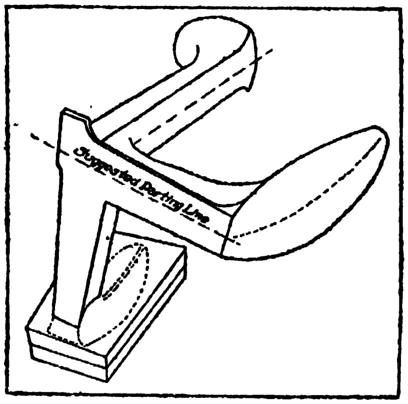
What do you consider the simplest and most effective method for producing this last on a molding machine, taking into consideration the following factors: (1) Scarcity of labor, which makes it necessary to employ machinery which will give the largest output per man; (2) What is the best type of box to use and how many castings should be made in each box (we have in mind either two or four); (3) Which is the better to use, a three or a four part box? That is to say a cope and drag and one or two middle parts.

Answer—Taking into consideration the points raised in your letter we would recommend that the pattern be split along the line shown in the accompanying illustration which would leave half of the large foot and heel in the cope. The small foot could be omitted from the pattern and made in a core. In this way the job could be made in an ordinary two part flask, or box, to use your term. We would not attempt to make more than one casting in each flask. A flask 8 x 10 inches with a drag 7 inches deep and a cope 4 inches will be large enough for the job and one man can handle it quite easily. If one man cannot meet the tonnage required, two men can be put to work, one on the copes and the other on the drags.

The advantages of this method are that the job is so simplified ordinary labor may be placed on it if necessary. The drag half of the pattern is mounted on a plain flat plate and the cope half on another which of course eliminates the necessity of making a parting on each mold. The two half cores for making the bottom foot are of the most primitive type and could be produced in quantity at a trifling expense.

We think that two plain hand squeeze, stripping-plate machines would meet your requirements.

In practice we would recommend that the drag frame be made in two sections, 4 and 3 inches respectively, the deep part to be placed around the pattern first, filled with sand, squeezed and struck off. The core to form the foot is then slipped over the stump of the pattern which has been left on for that purpose. The flat bed which has just been struck serves to locate it in the right position. The other half of the drag is then placed, filled with sand, squeezed, struck off, the pattern dropped through the stripping plate, and the mold lifted off, turned over and set on the floor. The cope, of course, is simple.



PERSPECTIVE VIEW OF LAST SHOWING PARTING LINE AND ALSO METHOD OF FORMING LOWER FOOT IN CORE

Tapered Drag Core Prints

Question:—For a number of years it has been our policy to use a tapered print in the drag as well as the cope for all gated metal patterns. Occasionally we receive patterns from various sources which have straight prints in the drag. We would like to know why some patternshops continue to make these straight prints. We believe the tapered print is the most efficient and would like to know why the straight print is preferred in some cases.

Answer:—Many things are done in pattern shops for which it would be difficult to find a reason. Some of them are simply the result of custom, while others are done with the object of getting by with the least effort. Any faults or shortcomings in the finished pattern are due to laxity on the part of the foundryman and not the patternmaker. In a great many cases the foundryman contents himself with outlining in a general manner the way he wishes a pattern made. He leaves the details to the patternmaker, who of course makes it the easiest way. There is no more work involved in making tapered prints than there is in making straight ones, but there is more work in putting a tapered end on a corebox and for that reason the prints are made straight.

On the other hand there are many things done in a pattern shop for which there are very good reasons. In the cases where cores made on core machines are used, a straight core print is most suitable because it saves the molder the time required to file a tapered end on each core. If the bottom core print is of a reasonable length and the core fits snugly, the cope core print may be dispensed with, or, if a cope print is used, the drag print may be made so short that it does not increase the difficulty of drawing the pattern.

Taking the question broadly we would say that where the job warrants the making of special coreboxes, tapered core prints are justified inasmuch as they are bound to draw without disturbing the mold. Where cores are made on a stock core machine the straight core print is the best; of course by a straight print is meant one with sufficient draft to draw properly.

Recovering Copper From Scrap and Sweepings

A method of treating copper waste for recovery of the copper recently patented in Great Britain consists in roasting the copper sweepings and scrap with not less than 15 per cent of common salt, and 25 per cent of sand. The roasting is carried out in a two-part furnace which is a reverberatory furnace with a muffle underneath which arrangement enables varying temperatures to be obtained, as the temperature determines whether cuprous or cupric chloride shall be formed. The former chloride is volatile and is recovered by condensation, while cupric chloride is recovered by leaching with water and sulphuric acid. From these salts the copper is easily obtained free from the impurities which contaminated the scrap.

The Shawinigan Electro Metals Co., Ltd., has moved its United States sales offices from the Leader-News building, Cleveland, to 1500 Westminster building, Chicago, where D. C. Falconer is located as sales agent. The company also has arranged to carry stocks of magnesium in warehouses in New York, Chicago and Detroit.

THE FOUNDRY

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Centralized Metallurgical Control

KNOWLEDGE is gained through experience, study and research. Every one who works in a foundry has more or less opportunity to acquire a limited amount of metallurgical experience and there are a number of books on metallurgical subjects through the study of which, some knowledge of the properties of foundry metals may be gained. Research, then is the only pathway to metallurgical knowledge which is closed to most foundrymen.

Many foundries do not employ a metallurgist. The superintendent is supposed to have sufficient practical knowledge of iron and its control to handle any problems which arise. Usually he gets along in a passable, though not entirely satisfactory manner, and occasionally he is confronted by a problem he can not solve. Sometimes on such occasions he obtains a book on metallurgy and tries to ascertain the remedy for his trouble. This, however, is difficult even with a limited knowledge of metallurgy, for while books cover the field broadly and in a general way, it requires a trained mind to follow and definitely lay hold of the cause and remedy for an individual case.

The foundry which employs a metallurgist is somewhat more fortunate. Its metallurgical problems are solved more readily; but let us consider what ability the average foundry metallurgist has for controlling the mixing, melting and pouring of iron. Usually he is a chemist and can analyze the metal and so control the mixture. Also, he usually has had a limited amount of experience in the lines manufactured by the particular foundry by which he is employed. In most foundries, however, only one metallurgist is employed, especially in the many small shops, and thus the solitary worker loses the advantages of an interchange of ideas so helpful to a broad, technical development. This lack is partially compensated through visits to other foundries and the meetings and proceedings of technical societies, but neither of these advantages fills the place of a broad, actual experience in contact with other workers in the same line. Some large foundries are able to employ several metallurgists and to give them ample facilities for research in the laboratories and shops, but even such foundries frequently lack the diversity of work which is so helpful in furnishing thorough experience to the metallurgist. Therefore, there is a long step ahead which has not yet been taken by the technical branch of the foundry industry. If all the foundries in different districts would combine to establish central laboratories from which the iron of the supporting foundries could be controlled, the advantages would be great. While such a laboratory need not be primarily of the research type, yet it should have enough equipment for solving every metallurgical problem with which the local foundries are confronted. A first class metallurgist could be placed in charge and with others under his direction, an interchange of ideas and an accumulation of broad experience could be obtained.

Trade Outlook in the Foundry Industry

ALTHOUGH not entirely unscathed, the foundry industry has not been seriously hampered by the multitude of industrial calamities which have assailed it indirectly to date. The steel strike found most plants well stocked with iron and although some special grades were off the market due to certain furnaces being down, the greater percentage of foundries are well stocked and continue to operate near full capacity. The threatened coal strike with its attendant spectre of a coke famine in most cases finds foundries prepared. Even though the strike occurs, most casting plants are stocked for at least two months' operation and the possibility of a mine strike of that duration is unthinkable.

Exceptions Exist

As in every instance, certain exceptions exist and these are found in the localities which are adjacent to the coke supplies which have been restricted by the steel strike. In the region surrounding Chicago and Milwaukee, in particular, the coke shortage was seriously felt even before the mine strike threatened still further curtailment. Many foundries in this district carry a very small stock of coke, depending upon nearby by-product ovens for prompt delivery. The steel strike, in a measure, crippled the ovens upon which these foundries depended and for the past few weeks coke has been sought from more remote sources. Coke dealers appreciating the situation have rushed quantities of both foundry and furnace grades into the region on consignment and the greater number of foundries, although somewhat embarrassed have been enabled to continue operations. Prompt coke prices reflecting the unprecedented conditions have commenced a series of fluctuations leading upward, and the finally established level is entirely problematical. Coke output is decreasing.

Prices of Raw Materials for Foundry Use

CORRECTED TO OCT. 27

Iron

No. 2 Foundry, Valley	$28.00 to 28.75
No. 2 Southern, Birmingham	28.00
No 2 Foundry, Chicago	28.75
No. 2 Foundry, Philadelphia	32.10 to 33.10
Basic, Valley	25.75
Malleable Chicago	29.25
Malleable, Buffalo	27.25 to 29.00

Coke

Connellsville foundry coke	6.00 to 6.50
Wise county foundry coke	8.00 to 8.50

Scrap

Heavy melting steel, Valley	$19.50 to 20.00
Heavy melting steel, Pittsburgh	20.00 to 20.50
Heavy melting steel, Chicago	19.00 to 19.50
Stove plate, Chicago	25.00 to 25.50
No. 1 cast, Chicago	28.75 to 29.25
No. 1 cast, Philadelphia	25.50 to 26.00
No. 1 cast, Birmingham	24.00 to 25.00
Car wheels, iron, Pittsburgh	22.00 to 23.00
Car wheels, iron, Chicago	24.50 to 25.00
Railroad malleable, Chicago	22.00 to 22.50
Agricultural malleable, Chicago	22.00 to 22.50

Prices Mount

A steady price advance is noted in all localities in foundry pig iron for prompt shipment and although only a small tonnage has been sold for the first half of 1920 a higher tendency is evident. In the Middle West keen competition exists between buyers to secure the small available tonnage for delivery this year. This competition taken with advancing production costs has brought $30 pig iron and $32 iron seems imminent. Southern furnaces in the main are sold out for the remainder of the year and except for an occasional carload lot no iron is available for prompt delivery. The small amount of advance selling for 1920 is abnormal for this period of the year. Unsettled conditions have acted to deter both buyer and seller. Furnace interests seem of the opinion that production costs will undoubtedly rise, and the few first quarter sales which have been made are from 75 cents to $2 a ton over prevailing prices at this time. Scrap has been strongly affected by strike conditions. The inquiry in some localities for cupola scrap to substitute for pig iron has forced prices up, and dealers in many quarters are stocking their yards full in expectation of higher prices yet to follow.

Business Unexcelled

The unprecedented growth and expansion in foundry business in practically all lines continues, and is evident in all sections of the country. When the wave of increased business started in the automotive industries some apprehension was expressed that the foundation of prosperity was not sufficiently stable to support the the growth. That this feeling was unwarranted has been shown by the soundness which has marked the castings market during the threatened steel strike and subsequent unrest. When it is realized that the United States produces about 80 per cent of the world's output of automobiles and perhaps a larger percentage of the various types of industrial tractors, and that the production methods in use in this country fit domestic manufacturers to meet the competition of any foreign nation, the stability of the industry will be appreciated. That increase in business which had its inception in the automobile field has spread to practically all lines of castings manufacture, until at present foundries, are in most cases unable to assume any additional business before the first of the year. Manufacturers of stoves in the Middle West, unable to secure supplementary castings to make possible additional output in their own works, are seeking to place orders both in eastern and western foundry centers. Other castings for various construction and domestic uses are almost impossible to obtain. Manufacturers of plumbers' supplies state that there is a shortage of over a half million bath tubs; fittings of both iron and brass are practically unobtainable; and cast pipe makers are booked through until the first of the year, although municipalities have not purchased as liberally this season as in the past. Even foundries which specialize in piano plate, and castings which under war rulings were deemed nonessentials are enjoying unprecedented demand. Malleable shops are booked beyond their capacity, considering the available labor supply. Railroad repair work, foreign car orders and the possibility of extensive buying of railway equipment when the roads revert to private management offer much encouragement to malleable producers. Nonferrous prices are strong. Prices based on New York follow: Copper, 20.25c to 20.50c; tin, 53.50c; antimony, 8.75c to 8.87½c; aluminum, No. 12 alloy, producers' price, 31.50c, and open market, 30.50c. Zinc is 7.75c, St. Louis.

Comings and Goings of Foundrymen

WILLIAM JORDAN has resigned as assistant foundry manager for the American Seeding Machine Co., Springfield, O., to become associated with E. A. Parker and Frank Hook in the formation of the Springfield Aluminum Plate & Casting Co, which will build a plant for the manufacture of aluminum vibrator plates and castings. Mr. Parker was formerly in the pattern and experimental department and Mr. Hook was head of the vibrator production department of the American Seeding Machine Co.

J. H. Deppleler, Metal & Thermit Corp., New York, has been elected vice president of the American Welding society, and P. F. Willis, president, Henderson-Willis Welding & Cutting Co., has been made a director of the society.

Pierce F. Hayden has accepted the position of foundry foreman with A. T. Nye & Son Co., Columbus, O.

H. H. Outwater, of Rogers, Brown & Co, has been transferred from Buffalo to the New York office of the company, where he will be connected with the selling staff.

Charles H. Schmalz, formerly with the Hanna Engineering Works, Chicago, has been made assistant factory manager for the Holt Mfg. Co, Peoria, Ill.

C. W. Cross has been appointed manager of western railroad sales of the Chicago Pneumatic Tool Co. Mr. Cross will have his headquarters in the Fisher building, Chicago.

Fred S Campbell has resigned as foundry superintendent for the Hitchings Co, Elizabeth, N. J., to take charge of the foundry operated by the Turner Machine Co., Danbury, Conn.

William H. Savage, builder of machine tools, and Everett E. Wilbar, assistant treasurer of the Union Foundry Co., both of Fitchburg, Mass., are among the incorporators of the People's Trust Co., of that city.

George J. Webster has resigned as general manager of the Charcoal Iron Co. of America. He has been elected to the board of directors of the same company.

Wilmer M. Wood, traffic manager of the United States Cast Iron Pipe & Foundry Co., has resigned this position to become general freight agent of the Kerr Steamship Co., New York City. Mr. Wood had been associated with the United States company for the past seven years.

Walter P. Coghlan has resigned as secretary and sales manager of the Klaxon Co., Newark, N. J., to become general sales manager of the American Hammered Piston Ring Co., Baltimore.

Lieut. Col. R. L. Streeter has resigned as general manager of the government's arsenal at Rock Island, Ill., to become assistant mechanical engineer of the Aluminum Co. of America, New York.

Harold B. Dinneen has accepted the position as assistant to R. W. Lea, production manager of the Moline Plow Co., Moline, Ill. Mr. Dinneen was formerly manager of the John Deere Plow Co.

Frederick K. Acker, who has been assistant purchasing agent of Mackintosh, Hemphill & Co., Pittsburgh, has been promoted to the position of purchasing agent succeeding Charles W. Forcier who recently resigned.

John F. Schurch, operating vice president of the T. H. Symington Co., Rochester, N. Y., will take charge of all western sales of the company. He still retains the title of vice president. His headquarters will be in Chicago

Otto Rabe, president of the Kelsey Foundry Co., Chicago, has become affiliated with Christian M. Gottschau and others in the incorporation of the Gottschau Steam Motors Co., 1770 Berteau avenue, Chicago.

J. R. King has accepted a position as production manager and foundry superintendent for the Fate-Root-Heath Mfg. Co., Plymouth, O. Until recently he was with the Monroe Foundry & Furnace Co., Monroe, Mich.

W. K Frank, vice president of the Damascus Bronze Co., Pittsburgh, presented a paper at the bimonthly meeting of the mechanical section of the Engineers Society of Western Pennsylvania held at the Union Arcade auditorium, Pittsburgh, Oct. 14. The subject of the paper was "Notes on Bronze and Babbitt Bearings."

H. Z. Kelley will establish offices in the Stambaugh building, Youngstown, O., as northeastern Ohio representative of the Keystone Bronze Co. Mr. Kelley was formerly secretary and assistant manager of the Falcon Bronze Co., Youngstown, O., having been associated six years with this company.

James Feasy, foundry superintendent, Ruston & Hornsby, Ltd., Lincoln, Eng., who came to this country to attend the foundry convention at Philadelphia, remained to visit a number of the larger foundry centers of the east and middle west, returning to England the latter part of October. He visited representative foundries in Pittsburgh, Chicago, Milwaukee, Beloit and Kenosha, Wis., Cleveland, Detroit, Toronto, Buffalo and New York.

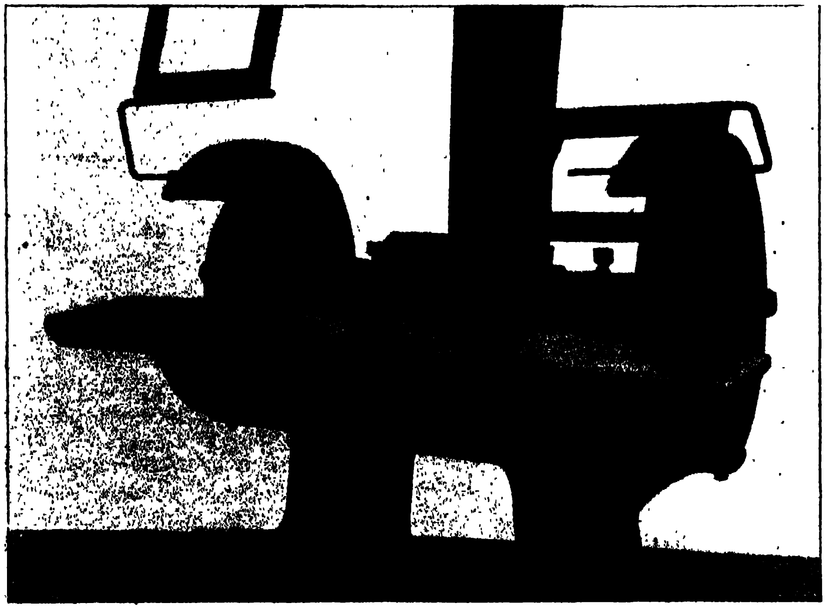
Charles W. Forcier, who for the past three years has been purchasing agent of Mackintosh, Hemphill & Co., Pittsburgh, recently resigned and has opened offices in the Union Arcade building as a sales engineer, in which capacity he will represent in western Pennsylvania, West Virginia and eastern Ohio, the Crucible Steel Forge Co., Cleveland, and the Exeter Machine Works, Inc., with a plant at Pittston, Pa., and executive offices at 30 Church street, New York. Mr. Forcier has been treasurer of the purchasing agents association of Pittsburgh for the past two years and will retain this position until the annual meeting of the association.

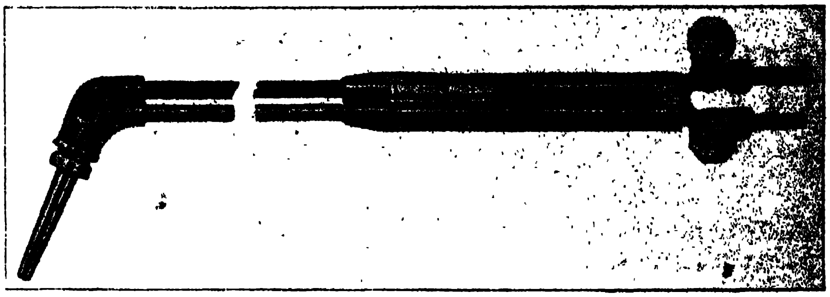
Addresses Pittsburgh Foundrymen

H. D. Gates, of the Pangborn Corp., Hagerstown, Md., was the speaker at the regular monthly meeting of the Pittsburgh Foundrymen's association which was held Oct. 14 at the Chatham hotel. Mr. Gates' talk, which was illustrated by lantern slides, was "Application of the Sand Blast in General Foundry Work." Carleton S. Koch, president of the Fort Pitt Steel Casting Co., McKeesport, Pa., recently elected president of the American Foundrymen's association, occupied a seat at the head table and was called on for a speech. He gave a brief talk relative to the affairs of the American Foundrymen's association, its problems and aims. He bespoke a more cordial interest in the annual convention and exhibit of the association on the part of the foundrymen and intimated that there was some possibility of the next convention being held in Pittsburgh provided an exhibition hall of sufficient size that was fairly convenient to hotels could be secured. Finding such an arrangement, Mr. Koch asserted, was getting to be a good deal of a problem in practically all of the larger cities of the eastern half of the country.

Safety in Grinding

Two unique attachments for use with an ordinary foundry stand grinder are shown in the accompanying illustration. These were devised by T. F. Jennings, foundry superintendent for the Utah Copper Co., Garfield, Utah. An adjustable sliding table is set immediately in front of the two wheels of a double stand grinder. This table may be moved forward or backward and tightened in position by a countersunk bolt. The table has been in use for about three years and since its adoption no instance has been noted where the work wedged, scalped or choked in the wheel. The workman is enabled to place a casting on the table and all the energy expended is pressing the work against the rotating surface of the wheel. Ordinarily, the combined weight of the casting and the pressure necessary to hold it against the wheel causes fatigue which is avoided through the assistance furnished by this device. It is possible to use a large wheel on one side and a smaller on the other if desired, as one side of the table may be advanced to compensate for the different diameters. The glass shield attached to the wheel guard is another device intended to be used with or without goggles to guard the workman's sight. The rigid construction of this guard combined with the hinged adjustable feature furnish a convenient shield for the workman's face against any flying particles. The pulley and belt have been fitted with a special guard since the photograph was taken.


ADJUSTABLE TABLE AND GLASS SHIELDS PROVIDE SAFETY FEATURES FOR GRINDING WHEELS


WELDING TORCH DESIGNED TO ELIMINATE BACKFIRING—SMALL NUMBER OF INTERCHANGEABLE PARTS COMPOSE EQUIPMENT

Welding Torch Embodies New Features

A new welding torch, which embodies a number of unusual features, has been developed by the Air Reduction Sales Co., New York. The torch consists of an unusually small number of parts, some of the threaded connections prevalent in earlier models of welding torches being eliminated. The torch heads are drop-forged of the same material as the tip, so that both parts are subject to the same coefficient of expansion and contraction. In order that operators cannot make the mistake of connecting the feed hose to the wrong connection the oxygen valve is equipped with a right hand thread and the acetylene valve with a left hand thread, the nuts on the feed hose having corresponding threads. The handle is knurled and bears a stamped gas pressure table which serves as a permanent source of information for the operator. The valve handles are of octagon shape and are on the left side of the torch. It is claimed that on account of the manner in which the gases are mixed this torch will not backfire.

Magnesite in the United States

Magnesite is mined in only two states in the United States and most of the output is used in steel-making plants and for the manufacture of refractory products and sanitary flooring. The domestic producers of magnesite suffered serious handicaps in 1918 by reason of restrictions on freight shipments, of the increase of the imports of magnesite from Canada from 3000 tons in 1917 to 20,000 tons in 1918, and of the use of substitutes for magnesite. Many of the producers who were not equipped with kilns lost business because the makers of magnesite refractory products insisted on having calcined or deadburned material, which is so much lighter in weight than raw magnesite that its shipment saves half the freight charges.

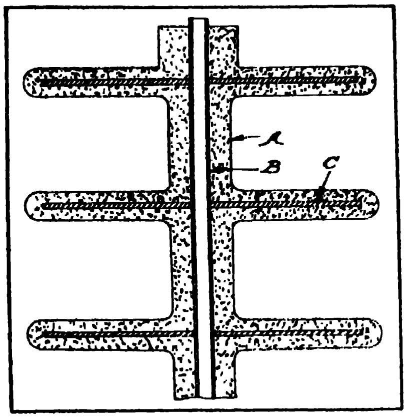
The country from which we imported most of our magnesite before the war was Austria-Hungary.

A report on "Magnesite in 1918," an advance chapter of the volume "Mineral Resources of the United States" for that year, has just been issued by the United States geological survey, department of the interior, and can be obtained free of charge on application to the director of the survey at Washington. The chapter, which was prepared by R. W. Stone and C. G. Yale, states the general condition of the industry, the prices, production, imports, and uses, gives many analyses of magesite, and describes briefly the foreign deposits.

Patents Drying Method

With the object of making cores that can be quickly dried without placing them in the core oven, a Michigan inventor, Alexander W. Finlayson, recently devised the core shown in the accompanying illustration. This core is patented.

In the ordinary method of making cores, the inventor claims that the baking process does not eliminate all the moisture from the core with the result that the molten metal generates a certain amount of vapor.



CORE PROVIDED WITH A PERFORATED TUBE FOR CARRYING AWAY VAPOR

In the accompanying illustration the core is shown at *A*, which is formed around a perforated tube, *B*, while *C* are baffle plates imbedded in the core. While the core is in a green state, it is moistened with gasoline which is ignited. As the liquid burns, the inventor points out that the heat generated is sufficient to dry the surface of the core rendering it fit for contact with the molten metal.

A substantial saving of time is claimed. Vapor in the interior of the core, caused by the heat of the molten metal, is carried off by the perforated tube *B*. It is said that this effectually eliminates blowholes in the casting which, of course, would result if no means were provided for disposing of the vapor as it is generated.

Portable Appliances for Drying Ladles

An improvement on the old wood fire for drying ladles is shown in two types in the accompanying illustration. The manufacturers state that the equipment shown at the left will dry a 50-ton ladle in 15 minutes. It consists of a 20-gallon steel oil tank, equipped with 150-pound pressure gage, oil and air regulating valves, one length of special oil resisting hose and one length of high pressure air hose, a burner with a long handle and deflecting plate. The tank is mounted on a strongly built angle iron truck which has handles and can be moved easily from place to place. It is supplied with two 18-inch wheels and two smaller guide wheels. Attached to the truck is a swinging davit, from which the burner with the deflecting plate is suspended by a steel cable. This plate may be lowered or raised as desired, by a steel cable connected to a small winding crank on the truck. The burner lights instantly, burns fuel, crude or kerosene oil and operates with compressed air from 20 to 100 pounds pressure. The flame of the burner is directed down toward the bottom of the ladle. It spreads evenly and quickly, and heats the sides and bottom of the ladle.

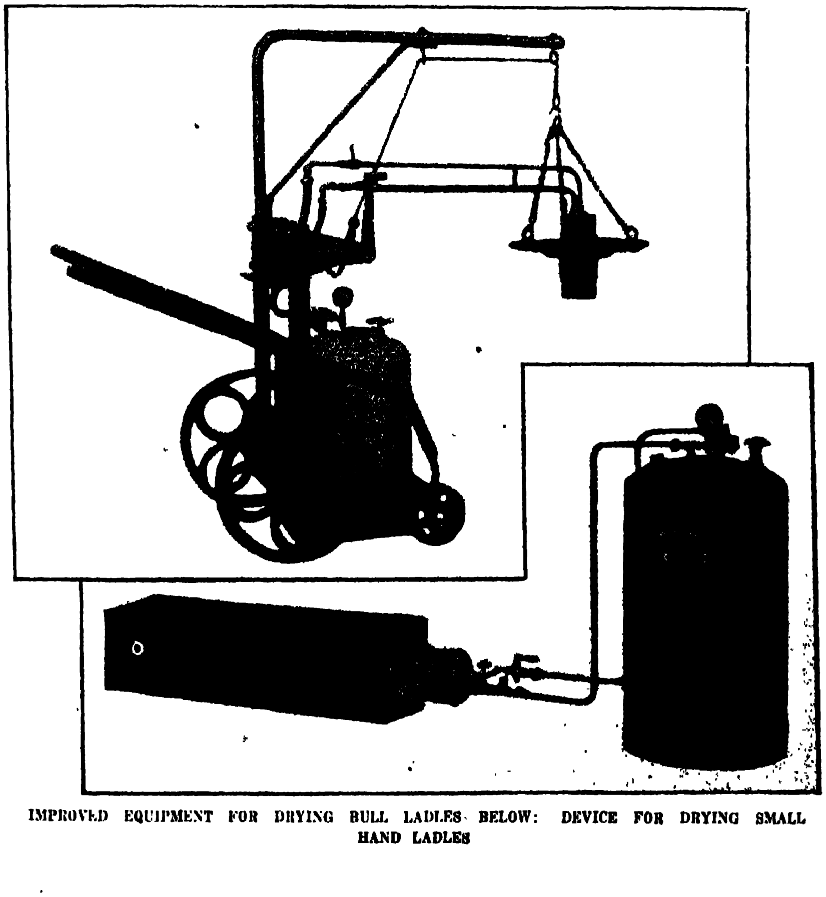
The other apparatus shown in the same illustration is designed for drying small ladles. It consists of a sheet iron box reinforced with angle iron and lined with fire brick, a furnace burner and a 20-gallon steel oil tank. The ladles are placed bottom up over the opening of the box and the flame of the oil burner shoots up through the openings, quickly and evenly drying the lining of the ladles. The fire box can be made any desired length to heat a number of ladles. The burner consumes any grade of fuel, crude or kerosene oil in connection with compressed air from 20 to 100 pounds pressure. This outfit is supplied with a regulating valve and mounted on a flange which is bolted to one end of the box. The steel tank is equipped with a 150-pound gage, oil and air regulating valves. The connections between the burner and the tank can be made with pipe. These installations have been developed recently by the Hauck Mfg Co., Brooklyn, N. Y.

Obituary

Arthur J. Storm, New York representative of the Dayton Foundry Co., Dayton, O., died of heart disease recently at his home in Flatbush, Brooklyn. Mr. Storm was 46 years of age.

William H Perrin died at his home in Pittsburgh recently. Born in Maryland 72 years ago he moved to Pittsburgh and for more than 40 years was connected with the Phillips & McLaren Co. of that city, having been foreman of the company's machine shop and foundry.

Benjamin F. Compton, for the past 10 years superintendent of the brass foundry of the Bethlehem plant of the Bethlehem Steel Co, died recently at his home in Bethlehem. Mr.



IMPROVED EQUIPMENT FOR DRYING BULL LADLES. BELOW: DEVICE FOR DRYING SMALL HAND LADLES

Compton was 62 years of age. Prior to coming to Bethlehem he had charge of the brass foundry of the William Cramp & Sons Ship & Engine Building Co., Philadelphia.

W. Cromwell Gurney, president and general manager of the Gurney Foundry Co., Toronto, Ont., died recently. Mr. Gurney was the eldest son of the late Edward Gurney, founder of the Gurney Foundry Co. He was 46, was born and educated in Toronto, and had been connected with the Gurney Foundry Co. since he entered upon commercial activities. He was a member of the Canadian Manufacturers' association. He is survived by his widow, one son and two daughters.

George W. Johnson, head of the Johnson Bronze Co., New Castle, Pa., died Oct. 12, at his home in that city He was born in Clarksville, Mercer county, Pa., 72 years ago and moved to New Castle in 1880 He conducted the Arethusa Iron Works from 1885 to 1899 when it was sold to the American Sheet & Tin Plate Co. Mr. Johnson had large interests in quarries and mines in Lawrence, Butler, Armstrong and Blair counties in Pennsylvania as well as in Maryland and in West Virginia.

Bernard Theodore Burchardi, vice president of the American Machine & Foundry Co., Brooklyn, N. Y., died recently at his home in that city, aged 70 years. Mr. Burchardi came to this country from Germany nearly 50 years ago. He built the great ocean pier at Palm Beach, Fla., and later constructed the Florida East coast and the Florida West railroad and also the Gulf stream road. Mr. Burchardi became general manager of the American Machine & Foundry Co. in 1902 and designed the building occupied by this company He was president of the Wahlstrom Tool Co., and was interested in other corporations which he served in various executive capacities.

What the Foundries Are Doing

Activities of the Iron, Steel and Brass Shops

Construction of a 1 story pattern shop is contemplated by the Lidgerwood Mfg Co, Newark, N. J.

Erection of a foundry and machine shop at the Charlestown navy yard is under contemplation.

Orders have been issued for dismantling the Dantzler Foundry & Machinery Co., Gulfport, Miss

Erection of a foundry, 80 x 200 feet, is contemplated by the Windsor Foundry Corp, Windsor, Vt

Erection of a foundry at 4514 Forty-sixth street Seattle, is being planned by James Muir

Woodrue & Edwards, Elgin, Ill, contemplate the erection of a foundry addition, 85 x 132 feet.

An addition to its foundry is contemplated by the Taylor Forbes Co, Ltd., Guelph, Ont.

The Yates & Johnson Co, Chippewa Falls, Wis., is erecting a gray iron foundry and a machine shop. The main building will be 100 x 225 feet.

The Gary Foundry & Machine Co, Gary, Ind, recently changed its name to the Calumet Foundry & Machine Co.

The F. & H Foundry Co, Newark, N. J, recently was incorporated with $60,000 capital, by Christian Franz, William Hewitt and Lena F. Moree.

Plans are reported being prepared for the erection of a foundry, 144 x 365 feet, for William Neiman, Hamburg, Pa

The Engman Matthews Range Co., South Bend, Ind, is reported planning to move its plant to Goshen, Ind.

Bids have been taken for the erection of a brass foundry for the Edro-Richardson Brass Co., 318 North Holliday street, Baltimore.

An increase in capital from $50,000 to $100,000, recently was made by the Rushville Stove Co., Rushville, Ind.

The Rell Tool Steel Foundry Co., Plymouth, Mich., has been chartered with $5000 capital, by Oliver Goldsmith and others.

The Jackson Stove & Stamping Co., Jackson, Mich, has been incorporated with $200,000 capital, by Walter V. Sherwood and others.

Construction of an addition, 50 x 75 feet, is planned by the Roesch-Kohl Enamel Range Co., Belleville, Ill.

The board of directors of the Liberty Foundry & Mfg. Co., Plymouth, Mich., have authorized an increase in capital, from $25,000 to $50,000.

Work has started on the erection of a foundry, 60 x 120 feet, for the A. Garrison Foundry Co., Pittsburgh.

The National Wire Wheel Works, Inc., 625 Equitable building, Baltimore, has been incorporated to do a general machine shop and foundry business, by Eli Frank, C. John Beeuwkes and Bernard R. Youngman

The Bridgeport Brass Co, Bridgeport, Conn, has awarded a contract for the erection of an addition to its foundry, 120 x 220 feet.

Contracts have been awarded for the erection of a foundry addition, 62 x 201 feet, for the American Hardware Corp, New Britain, Conn.

Plans have been drawn for the erection of a foundry, 80 x 140 feet, for the Standard Foundry Co, Buffalo

The Canton-Detroit Foundry Co, Canton, O, recently was incorporated with $50 000 capital, by A E McCuskey, Willard J Frey and others

The Springfield Foundry Co, Springfield, Mass., has awarded a contract for the erection of a 27 x 66-foot plant addition.

The King Foundry Co., St. Joseph, Mo, contemplates the erection of an addition to its plant O M King is president of the company.

Contracts have been awarded for the erection of a foundry, 42 x 82 feet, for the Franklin Machine Co., Providence, R. I

The Progressive Brass Mfg Co, Kansas City, Mo, is having plans drawn for the erection of a foundry, 83 x 150 feet.

The Eastern Iron Products Co., care of the West Side Foundry Co, Troy, N. Y., has had plans prepared for the erection of a plant, 60 x 400 feet.

The Pettibone-Mulliken Co, 110 South Dearborn street, Chicago, has awarded a contract for the erection of a foundry, 151 x 243 feet.

The contract for the erection of a foundry addition to the plant of the Packard Motor Car Co, Detroit, has been awarded to the H. G. Christman Co.

Work has started on the erection of a foundry building, 80 x 200 feet, for the Hamilton-Beach Mfg. Co., Racine, Wis.

Contracts have been awarded by the James Mfg. Co, Ft. Atkinson, Wis., for the erection of a foundry unit, 400 x 600 feet.

The Washington Molding Foundry & Machine Co., Washington, Pa., is reported planning the erection of a new foundry and cupola.

A site has been purchased at Louisville, Ky., by the Illinois Malleable Iron Co., Chicago, on which it plans to erect a modern plant.

Erection of an addition to its foundry, 83 x 222 feet, is reported being contemplated by the Crompton & Knowles Loom Works, Providence, R. I.

The Standard Foundry Co, Racine, Wis., has increased its capital from $50,000 to $100,000. The new issue of stock will be used for the development of the company's facilities.

The Superior Brass Foundry Co, Milwaukee, recently was organized with $15,000 capital, by Frank Schedeler, Philip Lecher and H. H. Wheeler.

Construction of a gray iron foundry, 80 x 120 feet, is progressing for the Walker Mfg. Co., Racine, Wis

The Crosby Steam Gauge & Valve Co, Boston, contemplates the erection of an extension to its foundry and an office building addition.

The Lakewood Foundry Co., Cleveland, recently was incorporated with $20,000 capital, by M. Garber, A Goldman, Engineers building, and others

Erection of a foundry is reported contemplated by the Albert Lea Tractor & Mfg. Co., Albert Lea, Minn.

Plans are being prepared for the erection of a foundry, 60 x 100 feet, for the Security Stove Mfg. Co, Kansas City, Mo.

Jenkins Bros., Ltd, 103 St. Remi street, Montreal, Que, have started work on the erection of a foundry

Contracts have been awarded for the erection of a foundry, for the Southern Stove Works, Inc., Hermitage road, Richmond, Va.

Architects have completed plans for the erection of a foundry, 70 x 90 feet, for the A. N. Peterson Co, Long Island City, N. Y.

Plans have been prepared for the erection of an addition, 65 x 120 feet, to the foundry of the Eagle Foundry Co., Minneapolis. H. D. Asleson, 3055 Fifteenth street, is engineer in charge.

Plans have been completed for the erection of a foundry, 150 x 250 feet, for the Haywood Foundry Co., Indianapolis. An electric crane will be included in the equipment.

Erection of a new core room, 50 x 100 feet, and a foundry building extension, 45 x 60 feet, is progressing at the plant of the H. P Deuscher Co., Hamilton, O.

The Mt. Vernon Foundry Co., Mt. Vernon, O, has purchased a site for a new building from the Mt. Vernon chamber of commerce. Erection of a $20,000 building on the site is contemplated.

The Fine & Sternhell Co., New York, foundry and factory supplies, recently was incorporated with $7500 capital, by S. Fine, A. Sternhell and H. Vogel, 208 West 115th street.

Among the recent incorporations is that of the Wymarsh Foundry, Inc., Hornell, N. Y. The company, which is capitalized at $30,000, was incorporated by F. A. Wygant, O. H. Martin and C. E. Shults.

Capitalized at $3000, the Loucks Mfg. Co., Sault Ste. Marie, Mich., recently was incorporated to manufacture machinery by Stanley D. Newton, Frederick Loucks and others.

Contracts have been awarded, both for construction and equipment, of a plant addition for the Benton Harbor Malleable Foundry Co., Benton Harbor, Mich. The building will be 80 x 200 feet.

The Millville Cast Iron Products Corp., 419 Market street, Camden, N. J., recently was incorporated to manufacture castings, etc., with $50,000 capital.

The Terminal Pattern & Model Works, Mulberry and Park streets, Newark, N. J., has awarded a contract for the erection of a plant addition, 3-stories, 25 x 90 feet.

Erection of a shop addition, 80 x 88 feet, to be used as a core room, is contemplated by the Atlas Foundry Co., Thirty-eighth and Burnham streets, Milwaukee.

Work on the erection of an addition to the plant of the Keeler Brass Works, Grand Rapids, Mich., is progressing. The building will be 75 x 100 feet.

The Anderson Foundry & Machine Works, Anderson, Ind., is reported planning the erection of a plant, 80 x 200 feet. W. N. Durkin is president of the company.

The Pfau Mfg. Co., Norwood, O., is having plans prepared for the erection of a foundry, 60 x 225 feet. Harry Hack, Telephone building, Cincinnati, is architect.

The Coshocton Iron Works, Monongahela City, Pa., is having plans prepared for the erection of a foundry, 158 x 300 feet. Construction will not be undertaken until next year.

The Minerva Engine Co., Cleveland, has purchased a site on which it plans to erect a plant, the first unit of which will be used for assembling engines and will contain a machine shop. A gray iron foundry will be erected later.

A contract has been let by the Waterbury Farrel Foundry & Machine Co., Waterbury, Conn., for the erection of a 72 x 102-foot machine shop and a 1-story hardening building. A foundry building will be erected later.

H. A. Lengfelder, president of the Orbon Stove Co., Belleville, Ill., [illegible] organizing a company at Birmingham, Ala., for the manufacture of stoves and stove castings. The company will be capitalized at $250,000.

The Remmel Mfg. Co., Kewaskum, Wis., has been organized with $50,000 capital to succeed the machine shop and foundry business of Nicholas Remmel. Additions to both foundry and machine shop are contemplated.

John E. Jordan, Grafton, Mass., formerly superintendent of the Standard Foundry Co., Worcester, Mass., has purchased the Pero Foundry Co., Worcester, Mass., and reopened it after a shutdown due to the molders' strike in that city.

A recent incorporation is that of the Allis Mfg. Co., Milwaukee. The company, which is capitalized at $50,000, will manufacture brass and bronze castings. Paul M. Kuder, Otto J. Juttner and John Garvey are the incorporators.

Moore Bros. Co., Joliet, Ill., manufacturer of stoves and furnaces, is about to start the construction of an addition to its foundry. The building will be 100 x 200 feet, and when completed will be devoted to the production of gray iron castings.

Organization of the Midway Foundry Co., St. Paul, with $100,000 capital, recently was announced. The company will build a plant on University avenue and will manufacture gray iron castings. J. H. Anderson, C. H. Wagner and T. Kaysen Jr. are officers of the new firm.

Shipyard and general jobbing work, as well as the manufacture of brass and aluminum castings, will be engaged in by the West Foundry Mfg. Co., Williamstown, N. J. The company plans to erect a modern plant. C. A. West, formerly of A. Booth Sons Co., is general manager of the new company.

A new corporation recently formed, is that of the Zobell Electric Motor Corp., Garwood, N. J., manufacturer of motors, etc. The company was incorporated in New York last April with $250,000 capital, but has opened a plant at Garwood, N. J. Officers of the company are: President, Fred G. Bell; treasurer, A. T. Zorbisch and secretary, F. E. Bucker.

In order to develop the production of tractors, the Traction Engine Co., Boyne City, Mich., recently increased its capital from $75,000 to $150,000. The company has enlarged its plant and remodeled the foundry of the Conrad Iron Works. E. M. Ackerman, secretary, has stated that no new equipment will be needed before mid-winter or early spring.

Incorporated for $250,000 in Ohio, a branch of the Lumen Bearing Co., Buffalo, is preparing to build a brass casting plant in Youngstown, O., for the manufacture of bronze bearings. The plant will include, smelting, refining, brass, bronze and aluminum foundries, a machine shop, tool room and grinding room departments. H. P. Narrock is general manager and W. H. Barr is president.

The Link-Belt Co., Chicago, is erecting an addition to its foundry at Indianapolis, which consists in completing a new furnace building. For the present only one furnace, which will be of 15 tons capacity, will be installed. Necessary machinery, such as rolling mills, sand blast and other foundry equipment; is now being purchased. The building will be 70 x 400 feet.

New Trade Publications

ZINC DUST.—This material is described in an 8 page booklet recently published by the New Jersey Zinc Co., New York. Two grades are described in detail, one being said to contain 95 per cent metallic zinc, while the metallic zinc content of the other averages between 92 and 94 per cent. The uses to which this material can be put are given.

SAND BLAST EQUIPMENT.—A 28 page booklet devoted to sand blast equipment has been prepared by the American Foundry Equipment Co., New York. The installations described include rotary table rooms, automatic tables, revolving barrels, blast cabinets, pressure tanks, dust arresters and accessory equipment. Each is fully illustrated.

CORE OVENS.—Catalog No. 148 recently published by the Whiting Foundry Equipment Co., Harvey, Ill., is devoted to a description of core oven equipment in general. Ovens equipped with three types of doors are described and illustrated. Core oven racks, core maker's benches, puller machines, core oven cars and trucks, etc., are among the equipment described. Illustrations of actual installations are given.

CORE OVENS.—The Ohio Blower Co., Cleveland, has published an 8 page bulletin, in which core ovens, core cars and racks and rotary ballbearing ventilators are described and illustrated. Complete data are given concerning each product and numerous illustrations, showing typical installations, etc., supplement the descriptions. A temperature chart taken on one of these ovens is given as a supplement to the booklet.

ROTATING ELECTRIC FURNACES.—The Booth Electric Furnace Co., 53 West Jackson boulevard, Chicago, has issued a four page bulletin covering details of construction and data of operation of a rotating furnace for melting nonferrous metals by the electric arc. Details of a test made by the Commonwealth Edison Co., Chicago, are included and many figures showing cost of operation as compared with melting with other fuels. Figures are also given showing cost of melting various metals.

PANEL BOARDS.—Bulletin No. 47942, devoted to a description of safety panel boards and cabinets, is being distributed by the Sprague Electric works of the General Electric Co., New York. These panel boards are applicable wherever the live front type of panel board may be used. Branch circuit switches and main switches are said to be distinctive features. They are simple in design and are positive in action. The blades of the branch circuit switches make direct contact with the branch connection bars, and the brushes of the main switches make direct connection with the main buses, providing the minimum number of electrical joints. The booklet gives full specifications and other data, together with a number of excellent illustrations.

UNDER FEED STOKER.—A 16-page booklet in which an automatic under-feed stoker is described and illustrated, recently was published by the Universal Automatic Under-Feed Stoker Co., Johnstown, Pa. The booklet explains in simple language the operation, etc., of the stoker. This nontechnical description, which is a deviation from the usual descriptions of similar appliances, will enable the average person to understand the workings of the equipment. The stoker is applicable to many types of furnace, including not only water tube, fire tube and various marine boilers, but also metallurgical furnaces for heating or melting ferrous and nonferrous metals, kilns, dryers, etc. Excellent illustrations supplement the description.

STANDARDIZED BUILDINGS.—The Milliken Bros. Mfg. Co., New York, has published a descriptive catalog in which structures designed by the company under the standardized truss unit system are described and illustrated. These buildings are all-steel and are furnished complete with doors, skylights, etc. They are suitable for all classes of industrial and manufacturing structures. The booklet is profusely illustrated showing buildings erected for the United States government and large manufacturers. One section is devoted to transmission towers, radio towers and special poles, which the company also builds. A companion booklet, has been also issued by the company. This booklet forms a guide to the construction of buildings from foundation to roof.

ELECTRIC BRASS FURNACE.—A bulletin entitled, "Electric Furnaces in the Brass Rolling Mill," has been published by the Electric Furnace Co., Alliance, O. It contains a number of illustrations, several of actual installations, and a description of an electric furnace which the company manufactures. The furnace described is of the standard resistance type. It is rated at 105 kilowatt in electrical capacity, has a hearth capacity of 1500 to 2000 pounds and a melting time of two hours. The cylindrical shell of the furnace is supported in front upon cast iron trunnions and in the rear by a screw which may be raised and lowered by a motor placed beneath the floor. A bowl shaped hearth, located in the bottom of the furnace, is lined with plastic material and is contained in a steel pan. The maximum capacity of the hearth is said to be a one-ton charge. Other data pertaining to the furnace are given.

ELECTRIC HOISTS.—A brief description of the salient points of a line of electric hoists manufactured by the Victor R. Browning Co., Cleveland, is given in an 8-page booklet, which the company recently published. According to the booklet, this line of hoists is built for use in structural shops, automobile factories, foundries, machine shops, loading platforms and other industrial works where continuous rough use is encountered. Some of the features of these hoists, as pointed out by the catalog, are: The cast iron hoist drum has all surfaces machined and contains deep grooves to receive the cable; the removal of six cap screws gives access to the compact controller, which can be removed as a complete unit; heat treated gears and disk load brake occupy an individual compartment and operate in oil; the motor, which operates on ball bearings, is contained in a separate compartment and is protected by a steel plate. Other parts of the hoist are described and the numerous illustrations are given.